JOURNAL OF THE SMPTE

85th SMPTE Convention • May 4–8 • Fontainebleau, Miami Beach

volume 68 • number 1 **JANUARY 1959**

JOURNAL of the
SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

PUBLICATION OFFICE TWENTIETH AND NORTHAMPTON STREETS EASTON, PA.

Editorial Office

55 West 42d St., New York 36, New York

Editor—VICTOR H. ALLEN

Advertising Manager—DENIS A. COURTNEY

• • •

Subscriptions to nonmembers, \$12.50 a year; single copies, \$2.00 for one-part issues, \$2.50 for special two-part issues. A 10% discount is allowed to individual members and accredited agencies on orders for subscriptions and single copies. A list of priced and gratis publications is available. Order from the Society's Headquarters Office, 55 West 42d St., New York 36.

• • •

THE SOCIETY is the growth of over forty years of achievement and leadership. Its members are engineers and technicians skilled in every branch of motion-picture film production and use, in television, and in the many related arts and sciences. Through the Society they are able to contribute effectively to the technical advance of their industry. The Society was founded in 1916 as the Society of Motion Picture Engineers and was renamed in 1950.

Membership in Sustaining, Active, Associate or Student grades is open to any interested person according to his qualifications. Information about membership, technical activities and standards and test films for the industry is available from Society Headquarters.

SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

Headquarters Office: 55 West 42d St., New York 36, N.Y. Cables: Somopict Telephone: LOngacre 5-0172

Executive Secretary: CHARLES S. STODTER

Published monthly by the Society of Motion Picture and Television Engineers. Publication office 20th and Northampton Sts., Easton, Penna. Second-class mail privileges authorized at Easton, Penna.

Printed by Mack Printing Company, Easton, Pa.

Journal of the Society of Motion Picture and Television Engineers

VOLUME 68 • NUMBER 1 • JANUARY 1959

Shutter Image Converter Tube for Multiple-Frame Photography

By WILLIAM O. REED and WILFRID F. NIKLAS

Various systems for ultra-fast photographic shutters are described. It is shown that shutter image converter tubes have the advantage of light gain and the adjustable frame rate and frame spacing. A shutter tube is described which is capable of delivering 16 frames on the viewing screen, utilizing electrostatic focusing and electromagnetic deflection. This tube employs an Sb-Cs (0) photocathode formed by external Sb-evaporation, a cascaded focusing system, deflection yokes which are assembled around the neck of the tube, a lumped PDA system, and a yellow-green modified P20 phosphor for the viewing screen. The tube is capable of exposure times in the range of 1 mμsec.

Introduction and Historical Review

The research which formed the basis for the development to be described herein was sponsored by the Aeronautical Research Laboratory at the Air Research and Development Command's Wright Air Development Center.*

Modern science imposes stringent requirements on the objectivity and precision of the investigation and measurement of high-speed phenomena. "Objectivity" is here to be understood in the sense that the measurement process is not permitted to interfere with the phenomenon to be investigated. Photography guarantees the required objectivity. However, the photography of fast progressing phenomena such as explosion processes, ballistic events and jet fuel injection is quite difficult if no special devices are used.[1] Cameras employing rotating mirrors and imprinting the image onto a fixed film result in speeds in the millisecond range. However, these devices, as well as conventional mechanical shutters, are not only relatively slow but suffer also from a substantial light loss.

Another group of high-speed shutters applied for the photography of ultra-fast phenomena makes use of electro- (and magneto-) optical effects. The liquid Kerr-cell[2] utilizing the electro-optical effect of rotating the plane of polarization produces shutter speeds of 10^{-8} sec. Photographs of the A-bomb explosions utilizing such a device were, therefore, quite successful. Solid-state electrooptical shutters, such as barium titanate layers showing the effect of electrical double refraction, have been developed recently[3] and approach the speed of the conventional Kerr-cell. Also, the magnetooptical Faraday effect in evaporated iron layers which has been investigated exhaustively[4] might be suited for shutter action.

Stroboscopic photography of illuminated objects in which the required high speed is obtained by aperiodic light flashes has been developed to a high standard.[5] Exposure times in the microsecond range are readily achieved.

All the techniques outlined so far suffer from the disadvantages of inherent light losses and of the impossibility of combining a sufficiently high shutter speed with a variable frame frequency. High-frequency stroboscopy and high-speed photography which use any one of these techniques are, therefore, limited to exposure times in the microsecond range or longer, or to intensely illuminated objects or both, as outlined above.

The application of image converters offers several advantages over those techniques. It is fundamentally possible to obtain shutter speeds in the millimicrosecond range. Furthermore, the light amplification, which can be achieved with an image converter, facilitates the photographic recording of the event. The earliest application of image converters for high-speed photography was the single-frame image converter utilizing high-voltage pulses.[6,7] As high-voltage pulses require a rather elaborate circuitry, considerable effort was concentrated on developing image converters driven with a low-voltage gating pulse.[8,9] Although the tubes developed so far represent an excellent solution for simple high-speed photography, the obtainable multiple exposure is restricted to 5 frames or less. Increasing the frame number decreases further the required mechanical recording speed of the camera. Obtaining 16 frames on the screen of an image converter (preferably combined with low-voltage gating) lies within the capability of such a tube. As this technique represents the *non plus ultra* at the present time, the advantages obtained compared with simple shutters are summarized as:

(1) The shutter image converter tubes are as fast as Kerr-cells or faster.

(2) The resulting light gain facilitates photographic recording of less bright scenes.

(3) The required magnification can be adjusted by tube design and/or a proper choice of the operating voltages.

(4) Mechanical recording speed may be reduced by a factor equal to the number of frames on the screen.

(5) Very-high-frequency stroboscopy with adjustable frame rate and frame spacing is possible.

In this paper we shall discuss a shutter image converter tube employing electrostatic focus and electromagnetic deflection which can be used for ultra-fast photography with 16 frames on the viewing screen.

After describing the main components of this tube, i.e., the photocathode, electron-optical and gating systems, phos-

Presented on October 24, 1958, at the Society's Convention at Detroit by William O. Reed, Edgerton, Germeshausen & Grier, Inc., 160 Brookline Ave., Boston 15, Mass. (formerly with The Rauland Corp.), and Wilfrid F. Niklas (who read the paper), The Rauland Corp., 4245 N. Knox Ave., Chicago 41, Ill.
(This paper was received on August 8, 1958.)

* Contract No. AF 33 (616)-2095, (WADC Tech. Rept. 55-155), and Contract No. (33-601)-58-3744 with the Engineering Physics Research Branch of the Wright Air Development Center.

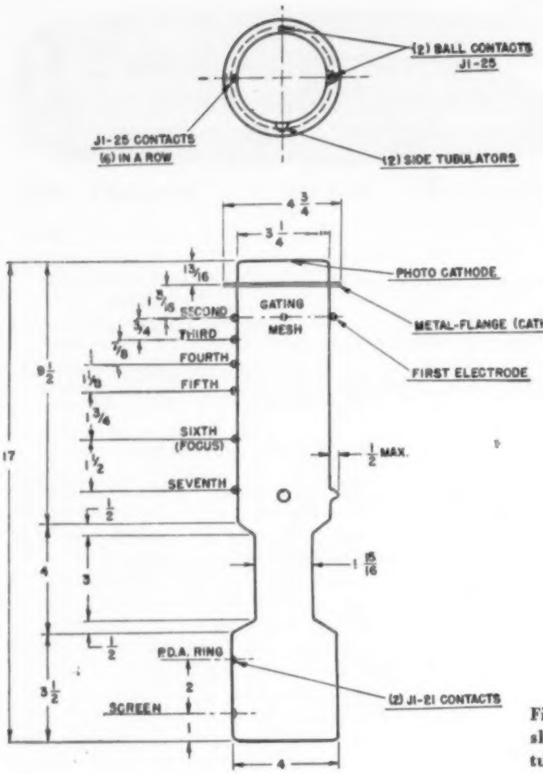


Fig. 1. Dimensional view of shutter image converter tube.

Fig. 2. Shutter image converter tube.

phor screen and deflection yoke, we shall proceed to outline the associated deflection and gating circuitry. Finally, we shall discuss essential operating parameters such as speed, brightness gain, resolution and raster distortion.

Description of the Shutter Tube

The shutter image converter tube for high-speed photography employs electrostatic focus and electromagnetic deflection. The tube is shown in a dimensional view in Fig. 1 and in the photograph of Fig. 2.

The electron-optical system is shown schematically in Fig. 3. The incident visible light is converted into electrons by the semitransparent photocathode (1). The emitted electrons penetrate the mesh (2) which is used for the gating of the beam. Thereafter, the electrons are focused by the electrostatic focusing assembly, consisting of the electrodes (3) to (9),† onto the fluorescent screen (12). The entire electron beam is deflected by the deflection yoke (10), resulting in 16 frames on the viewing screen for a single position of the light image on the photocathode. (The time during which the photocathode is exposed to the light image may be long compared with the frame time.) A cascaded post-deflection acceleration system (11), (12), is employed between the deflection system and the viewing screen.

The diameter of the photocathode is $1\frac{3}{4}$ in. and that of the tubing, 3 in. The diameter of the viewing screen is approximately 4 in. The tube possesses an overall length of 17 in.

It will be noted in Figs. 1 and 2 that the glass envelope consists of tubing of three different diameters. The photocathode and the focusing electrode structure are enclosed in tubing of approximately 3-in. diameter, to permit the mounting of the large-diameter electrodes on glass supports. Progressing toward the viewing screen, we encounter next a section $1\frac{15}{16}$ in. in diameter. This diameter is narrower to permit the best use of the electromagnetic deflecting fields (see later). The PDA-system and the viewing screen itself are enclosed in glass tubing of 4-in. diameter.

After these introductory remarks about the tube as a whole, we shall describe the main components in detail.

Photosurface

The photosurface used is of the Sb-Cs (0) type. This photocathode has been chosen as it possesses a relatively long-wavelength response maximum (approx. 5000 A units) and a rather high sensitivity.[10] Recent developments[11] have indicated that it is quite feasible to use a photocathode of type Sb-K-Na-Cs, which has a sensitivity maximum about 15% higher than that of Sb-Cs (0) surfaces. However, the maximum lies at around 4000 A units. In the range from 5000 to 6500 A units, the sensitivity of both types of surface is about the same.

One problem encountered with semitransparent, Sb-Cs (0) photocathodes under pulsed operation is the speed of response of the photoelectron emission to the changing illumination both during and between the viewing times as determined by the gating pulses. It is well known that photoelectrons are emitted in less than one millimicrosecond after a low-level illumination strikes the photocathode. However, in shutter tube applications where an entire picture must be stopped in less than a few microseconds, the illumination level necessarily becomes quite high (about 550 ft-c at the photocathode for a one-microsecond exposure using ordinary photographic recording techniques). This results in appreciable current from each surface element (approx. 4×10^{-6} amp/sq cm for a 1-μsec exposure).

Semitransparent Sb-Cs (0) photocathodes have a surface resistivity of the order of several tens of megohms per square.[12,13,14] When an area embracing hundreds of surface elements is illuminated sufficiently high for short exposures to be recorded, the resulting voltage drop between this area and the photocathode contact may be high enough to cut off or distort the flow of photoelectrons through the gating mesh. In addition, the capacity of the surface elements yields a charging time which may become an important factor in the microsecond exposure time range. It is, therefore, essential that the resistance between any surface elements and the external cathode circuit be made adequately low. Several methods to achieve this are well known today. The most suitable method appears to be the application of a conductive transparent coating to the glass prior to the deposition of the photolayer.

Thus, the photocathode window is "iridized." A transparent conductive coating was applied according to a procedure recommended by Gomer.[15] The procedure consists essentially of diffusing stannous chloride vapors into the glass until the plate shows a purple inter-

† Electrodes 1 and 2 are the cathode and mesh, respectively.

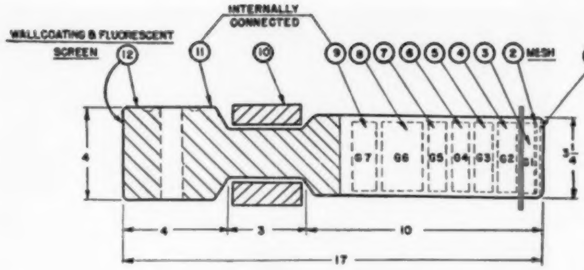


Fig. 3. Diagrammatic illustration of electrostatic system of the shutter image converter tube.

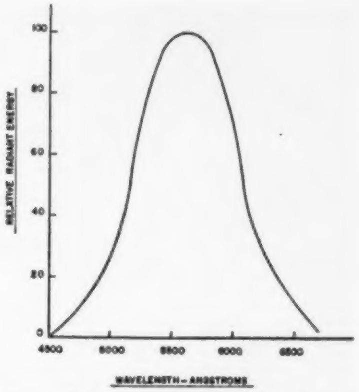


Fig. 4. Spectral energy emission characteristic of P-20 phosphor.

ference color. The resistivity of the iridized glass plate was less than 100 ohms/square and the transparency greater than 85%. Utilizing such a conductive coating behind the photosurface results in an extremely fast response of the photoelectrons to the gating pulses, enabling shutter speeds in the order of one millimicrosecond to be achieved.

The photocathode is formed on an externally evaporated Sb layer. The photocathode window pre-sealed into a Kovar metal flange (Fig. 1) and carrying the transparent conductive coating is inserted into a demountable pump station and a predetermined amount of Sb is evaporated completely from a small nickel boat. The spacing between the boat and the target surface is such that an evaporated Sb layer of even thickness is guaranteed.

As Sb oxidizes readily at room temperature, care must be taken that the exposure of the evaporated Sb layer to room air is kept as short as possible.

After completing the Sb evaporation, the two tube halves are joined together by means of a "cold" heliarc weld. The Kovar metal flange represents electrically a part of the cathode and may be used as cathode contact.‡ It is interesting to note that the capacity between the photocathode and the gating mesh is quite small in spite of the presence of the Kovar flange (see later).

An externally evaporated Sb layer requires very careful handling, but the resulting advantages listed below more than compensate for this inconvenience:

(1) even photosurface sensitivity due to an even Sb thickness;

(2) no mesh emission, as no photosurface is formed on the gating mesh; and

(3) reduced leakage between electrodes and improved high-voltage performance.

It is noteworthy that a photocathode formed on an externally evaporated Sb layer is quite comparable in sensitivity to a photocathode formed on an Sb layer evaporated *in situ*. The back surface sensitivity measured with incandescent light (2870 K color temperature) lies between 20 and 40 μamp/lumen.

‡ Some tubes carry contacts through the photocathode window. In such a case the Kovar flange has to be connected externally to the mentioned contacts.

The Electron-Optical System

It is possible to design focusing systems for image converters employing electrostatic or magnetic lenses. Image converters utilizing magnetic or both magnetic and electrostatic electron-optical systems suffer generally from S-band distortion and image rotation,[7] which can be corrected only by critical adjustments and restrictive operating conditions.

The application of a point symmetric, two-electrode focusing system as described by Schagen and co-workers[16] represents an excellent solution for large-area imaging with minimized edge distortions caused by the curvature of the image plane. It is difficult, however, to combine such a system with the consecutive deflection required for 16 frames.

In the shutter image converter tube described here, we apply a purely electrostatic focusing system consisting of several cascaded cylindrical metal electrodes mounted on glass supports. The cathode is thus included in the electrostatic fields forming the focusing lenses. As such an immersion lens system is generally severely troubled by a strong curvature of the image plane,[17] special care must be taken to flatten the equipotential plane in the neighborhood of the cathode. This has been achieved by choosing the proper length and voltage ratios for the electrodes.

A cascaded system has been selected as it possesses a minimum amount of geometric and electronic aberrations if areas in the marginal space are to be focused.[18]

The focusing system, together with the gating grid, is shown schematically in Fig. 3. It consists of the photocathode, the gating electrode (electroform mesh), four accelerating electrodes (G1 to G4) and a saddle field lens formed by the electrodes G4, G5 and G6. As pointed out above, it is possible to correct edge defocusing by changing the voltage ratios of the four accelerating electrodes. Doing this will also adjust the magnification, thus offering an additional degree of freedom in the application of the tube. The main focusing action is carried out by the saddle field lens.

The gating electrode consists of a 200-line mesh grid. About 100 volts are required to cut the tube completely off. The mesh is located in such a position that it is not imaged onto the viewing screen.

Fluorescent Screen and PDA System

A special type of P-20 phosphor was used for the viewing screen. The emission spectrum of this phosphor favorably matches with the sensitivity of the common photographic material. The relative energy as a function of wavelength is shown in Fig. 4. The average particle size is smaller than 5 microns. Differential sedimentation has been utilized to select the smaller particles from the commercial batches, thus resulting in a most probable particle size between 2 and 3 microns. Such a particle size permits a resolution of 20 to 30 lines/mm.

The screen is aluminized to increase the brightness output and to avoid image distortions due to local charge accumulations.

The PDA system consists of two aquadag rings painted on the walls of the 4-in. diameter glass tubing and the screen spaced by chromium-oxide bands. A lumped system has been chosen in preference to a distributing spiral as the adjustment of the PDA ratios facilitates the correction of edge distortions introduced by the nonflatness of the equipotential planes near the cathode of the tube.

Deflection Yoke

Electromagnetic deflection has been chosen for the shutter image converter tube as this system is to be preferred to electrostatic deflection, considering the extraordinarily large cross section of the electron "beam" at the deflection center. In addition, magnetic deflection distortions can be corrected more readily than can electrostatic deflection distortions.

The deflection angle decreases with the square of the neck diameter at constant power consumption.[19] Thus, it is necessary to keep the neck diameter at the location of the deflection yokes

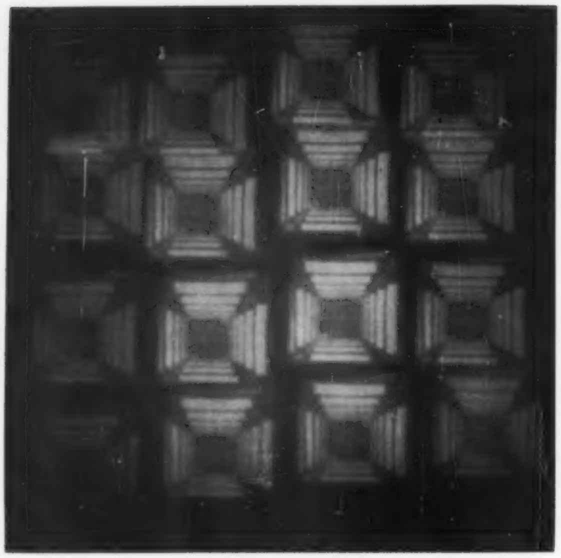


Fig. 5. Test pattern with single light pulse from camera lamp. Duration of light pulse, 75 μsec; frame period, 0.5 μsec.

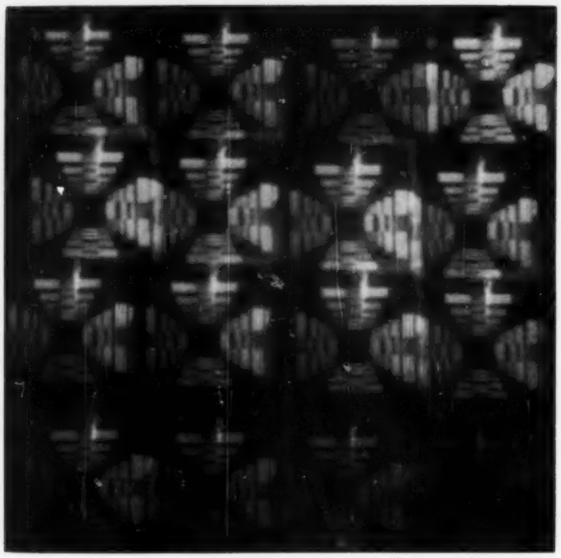


Fig. 6. Test pattern illumination of single 3-μsec light pulse. Exposure time for a single frame is in the range of 10 mμsec.

as small as possible. Therefore, a $1\frac{15}{16}$-in. glass tubing has been inserted between the 3-in. tubing containing the electron optical system and the 4-in. tubing of the screen section.

The deflection yokes cannot be pushed on the neck as usual. However, it is possible to pre-assemble the yoke coils and to just barely interleave the laminations so that the yoke can be assembled on the reduced neck diameter provided for the purpose by simply pushing the laminations together.

A modified push-pull yoke is used which has a mu-metal core and very fine wire, pie wound, to reduce capacities and give optimum distributed resolution.

Associated Circuitry§

Very high instantaneous sweep speeds and very rapid "settling" time after the sweep has reached the correct displacement are necessary to meet the requirements of exposures separated by approximately one microsecond. During this one microsecond the shutter tube must be blanked, the sweep started and stopped, and time allowed for "settling" before the shutter tube is turned on for the next picture.

To reduce the sweep rates, a zig-zag type of scan has been used. Sixteen pictures were chosen as a compromise between the information content of each picture, the maximum useful field of view of the photographic camera available with no additional loss in film resolution or speed, and the peak power-consumption requirements of the deflection system. The first picture is deflected simultaneously up 1.5 picture widths and to the left 1.5 picture widths from a central reference point. This is the maximum displacement of the sweep. Thereafter for each successive picture there is a displacement equal to 1.0 picture width in either the horizontal or the vertical direction. The sweep progresses successively three jumps to the right, then down one jump, then successively three jumps to the left, down one jump again, then three jumps to the right, then down one jump to the last row and finally three jumps to the left.

This scan pattern requires the same performance from the horizontal and vertical sweep systems. The waveform applied to the vertical amplifier is easier to generate, but the slope of the vertical steps must be as steep as that required by the horizontal sweep. Therefore, both sweep amplifiers are identical and the deflection yoke is symmetrical.

Performance of the Shutter Image Converter

Typical Operating Voltages

As mentioned above, edge distortions as well as the resulting magnification depend on the voltages applied to the electron-optical system. The representative electrode voltages for optimum focus given in Table I, therefore, should not be taken as absolute requirements.

In operating the tube, a 0.060 mu-metal shield extending beyond the tube should be used for shielding against stray magnetic fields.

Performance of the Tube

As mentioned above, the photocathode has a *back surface sensitivity* of 20 to 40 μamp/lumen measured with a light source of a color temperature of 2870 K. The gating voltage is about 100 v. The *resolution on the viewing screen* under d-c conditions is approximately 20 lines/mm. The resolution under pulsed operation is slightly lower; namely, 15 lines/mm. This difference is due to an inherent high-frequency jitter which tends to wash out the lines in the image.

The *actual light flux density gain* is 48. This gain has been determined by measuring the light flux on the photocathode and on the viewing screen with a MacBeth-type photometer. The brightness gain depends on the demagnification and is, therefore, generally larger than the light flux density gain.

It is possible to reproduce 16 frames from one image picked up by the photocathode. In this case the demagnification lies around 3/2. The *exposure time* for one frame can be in the range of 10^{-8} to 10^{-9} sec.

The performance data of the shutter image converter tube are summarized in Table II.

Table I. Typical Operating Electrode Voltages for Optimum Focus.

	Volts
Cathode	−40
Gating electrode (mesh)	−100 to 0 (off-on)
Focusing electrode:	
First	+70
Second	+160
Third	+280
Fourth	+3,150
Main lens electrode	+1,050
Final focusing electrode	+10,000
First PDA ring	+10,000
Second PDA ring	+20,000

§ The circuitry necessary to drive the shutter tube was built by Syntronics Instruments, Inc., Addison, Ill., and designed by Dr. Henry O. Marcy; it is described in detail in WADC Tech. Rept. 55-155.

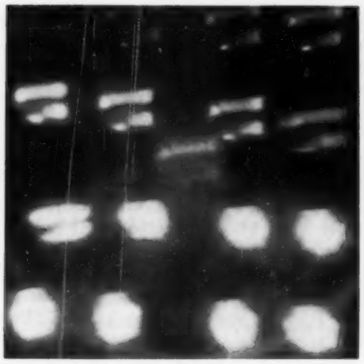


Fig. 7. Arc discharge in the camera lamp. Each frame exposed for 0.3 μsec.

The performance of the tube‖ will be further demonstrated using Figs. 5 to 7. Figure 5 shows a multiple-frame picture of a test pattern illuminated by a single light pulse from a "Kemlite" lamp (Special No. SP 72, working at 36 wsec input). The duration of the light pulse is 75 μsec. Sixteen frames have been taken, and the size of each frame on the fluorescent screen is 0.9 cm × 0.9 cm. The frame period is approximately 0.5 μsec. The maximal resolution on the photographic film is 8 lines/mm. Camera data: double Wollensak f/1.9 lens back to back, magnification 1:1.

‖ Some practical applications of the Shutter Image Converter Tube are described in the WADC Technical Report 58-422, ASTIA Document No. AD 155848, *A Multi-Frame High Speed Shutter Camera* by 1st Lt. Stanley J. Wooten, Aeronautical Research Laboratory, Wright Air Development Center, June 1958.

Table II. Performance Data of Shutter Image Converter Tube.

Photocathode:	
Resistivity	Smaller than 100 ohms/sq
Sensitivity	20 to 40 μamp/lumen
Spectral response	At 5000 A max
Control Grid:	
Gating pulse	100 v (5 v/kv screen potential)
Input capacitance (Grid 1 grounded cathode)	15 μμf
Magnification	0.67
Resolution:	
D-c operation	20 lines/mm
Pulsed operation	15 lines/mm
Conversion Gain[1]	48
Electron Transit Time[2]	0.002 μsec
Camera Specifications:	

	Min exposure time	*Min time between frames*	*No. of frames*
Single picture[3]	0.003 μsec	—	—
Multiple picture	0.003 μsec	1 μsec	16

[1] Wavelengths of incident radiation matched to peak spectral sensitivity of the photosurface.
[2] Between cathode and a point on the axis of the tube where the gating voltage does not influence the imaging properties of the electron-optical system.
[3] If a certain amount of distortion in the reproduced images is permissible, the minimum exposure time may be reduced to approximately 0.002 μsec. Tubes of the type described here have been operated successfully with an exposure time of 0.0013 μsec.

Figure 6 shows a multiple-frame picture of a test pattern illuminated by a light pulse of 3-μsec duration. The exposure time for a single frame is in the range of 10 mμsec. The resolution of the photographic film is 10 lines/mm. The underexposure for the first few frames is the result of too short a flash duration to cover the full 16 frames.

Figure 7 is the direct view of an arc discharge in the "Kemlite" lamp. Each frame is exposed for 0.3 μsec. The frames are spaced by 2 μsec. The building up of the arc can be seen very clearly.

References

1. D. A. Jones, *High Speed Photography*, Wiley & Sons, New York, 1952.
2. J. Kerr, *Phil. Mag.*, *50:* 337, 1875.
3. A. C. Koelsch, *IRE Nat. Conv. lecture*, 23.5, 1957.
4. H. Koenig, *Optik*, *3:* 101, 1948.
5. F. Fruengel, *Z. angew. Phys.*, *6:* 183, 1954.
6. R. A. Chippendale, *Phot. J.*, *92B:* 149, 1952.
7. R. A. Chippendale and J. A. Jenkins, *Philips Tech. Rev.*, *14/8:* 213, 1953.
8. B. R. Linden and P. A. Snell, *Proc. IRE*, *45/4:* 513, 1957.
9. R. G. Stoudenheimer and J. C. Moore, *RCA Rev.*, *9/2:* 322, 1957.
10. V. K. Zworykin and E. G. Ramberg, *Photoelectricity*, Wiley & Sons, New York, 1949.
11. A. H. Sommer, *IRE Trans.*, *NS-3:* 8, 1956.
12. W. J. Harper and W. J. Choyke, *J. Appl. Phys.*, *27/11:* 1358, 1956.
13. J. H. deBoer and M. C. Teves, *Z. Physik*, *74:* 60, 1932.
14. M. Sugawara, *J. Phys. Soc. Japan*, *11/2:* 169, 1956.
15. R. Gomer, *Rev. Sci. Instr.*, *24:* 993, 1953.
16. P. Schagen, H. Bruining and J. C. Francken, *Philips Research Repts.*, *7/2:* 119, 1952.
17. E. G. Ramberg and G. A. Morton, *J. Appl. Phys.*, *7:* 451, 1936.
18. P. H. Gleichauf and H. Hsu, *IRE Trans.*, *ED-4/1:* 63, 1957.
19. H. Baehring, *Hausmitteilungen d. Fernseh A.G.*, *1/2:* 15, 1938.

Rapid Film-Density Evaluation

By JOHN L. BOOR

As a preliminary to the establishment of standards for the density range of television films, a uniform method of density measurement is presented. The equipment and its use, accuracy of the system and simplifications of it for rapid surveys are discussed.

For a number of years, film has been produced for viewing on a screen, where density range was best judged subjectively and actual measurement was confined to significant areas. The properties of the human eye were the only ones that were really important. Some effort has been made to standardize density range, but it was not vital that close tolerances be maintained as long as the result was pleasing to view.

With the advent of television pickup devices and the accompanying restrictions of the system as a whole, it has become increasingly apparent that something more must be done regarding film density evaluation.

First among these restrictions is the fact that most television devices used in converting light energy into electrical energy do not respond in a totally linear manner. Indeed it can be demonstrated that the scene-brightness range reaching the photosensitive tube must definitely be restricted, and that to exceed this range produces distortions in the system which result in loss of detail, incorrect gray-scale reproduction, etc. Thus peak-to-peak measurements in all parts of the film become critical and the term "significant area" becomes obsolete, as voltages produced in "nonsignificant" areas must also be held within limits to satisfy clipper, clamper and video amplifier circuits in the system.

It has been the consensus for some time that prints for release on a television system should be somewhat restricted in range compared with those used for theater projection. Among television engineers there has been a wide divergence of opinion about what these standards should be. But before usable standards can be set, a uniform method of measurement is absolutely necessary, and it is to this end that this paper is written. It is the author's belief that the method of measurement and terminology account for most of the present honest differences of opinion on what standards should be adopted.

It is not the purpose of this paper to comment on standards for the density range of films used in television, but

A contribution submitted on September 17, 1958, by John L. Boor, KCTS-TV, University of Washington, Seattle 5, Wash.

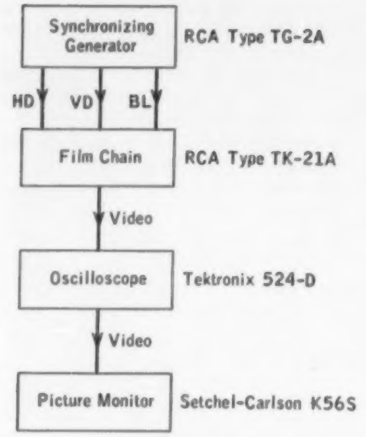


Fig. 1. Systems diagram of equipment used in tests.

rather to suggest a new, inexpensive, uniform and rapid method of surveying the film to determine its compatibility with the television system. Some presently used densitometers will not measure a small enough area of a frame to be useful. Accuracy of others is suspect. All are tedious to use to the point where it is impractical to measure all parts of all scenes to ensure compliance with future standards, and no film producer is in a position to state that the whole of a reel of film will fall within these standards.

The densitometer to be proposed may be simple or complex. It will measure the density range of an entire frame as it is being projected — either statically or dynamically — or it will measure any area of the frame down to 1/500 of picture height by 1/100 of picture width. On a 16mm frame this is a rectangle measuring approximately 0.6 mil by 4.1 mils. This is not materially smaller than can be measured with a microdensitometer, but the speed and convenience of the proposed system are distinct advantages.

To make the procedure clear, a description of the various devices that may be employed is given, together with a diagram of the equipment used for the tests described (Fig. 1). And following the description of the tests is a suggested simplification which would provide essential information on peak white and peak black densities, which would serve for cursory observations.

Suggested Equipment

Synchronizing Generator. It is necessary that some type of sequential scanning of the picture material be accomplished. This may be done in several ways:

(1) A standard television station synchronizing generator may be employed to drive the pickup device.

(2) A substandard generator may be used — any of the several types employed in industrial vidicon camera systems.

(3) Synchronizing information may be picked up from a local television station and used to drive the film pickup device.

Film Pickup Device. A number of devices are readily available for converting light energy into electrical energy, and if a rapid sequential scanning of the picture can be produced in conjunction with one of these, the unit is suitable for application. Such devices are:

(1) vidicon camera chain,
(2) image-orthicon camera chain,
(3) iconoscope camera chain, and
(4) flying-spot scanner.

Oscilloscope. Several oscilloscopes which are on the market already have all the features necessary or can be modified to meet the following requirements:

(1) The oscilloscope must have a variable-speed time base in order that any one or all the lines of the scanned picture may be viewed.

(2) Amplifiers must be flat to 8 mc to ensure accuracy in fine-detail areas of the picture.

(3) A 5-in. display tube is a minimum.

(4) The oscilloscope must have an output capable of driving a monitor to produce a picture and at the same time provide some indication of what material is visible on the oscilloscope, such as brilliance modulating the line or group of lines under consideration.

(5) Some accurately controlled phase-shift network must be available so that the operator may freely observe whatever section of the frame he chooses.

Picture Monitor. The picture monitor need have no special characteristics except that it must be compatible with the type of scanning employed.

Steps in Development and Use of System

Although considerable study has been given to the transfer characteristics of the vidicon (and other devices), there was no absolute way of relating all the variables to produce an accurate direct-reading device. A comparative system was decided on, and the first trial was made under static conditions. This involved the preparation of a 16mm frame on which there were six vertical bars. Each bar represented a particular density, and the bars were sufficiently wide to permit measurement on a standard Eastman Type 1A Densitometer.

At this point a brief reference to standards is necessary. It is the author's belief that the transfer characteristic of the vidicon is such that picture information on any piece of film must fall within a range of 0.25 to 1.85; therefore the 16mm frame referred to above had a density range of film base to 2.0 in six steps. Considerable effort was made to arrange these steps so as to produce a linear effect on the oscilloscope. The limited facilities available did not make this possible. A standard setup and reference slide or film are required, which will produce a linear stair-step display on the oscilloscope, in order to check the response of the reproducing equipment and calibrate the oscilloscope scale. The inability to reach the desired linear condition was not considered serious, however, as the frame produced gave six points of reference on the oscilloscope face, from which fairly accurate interpolation was possible.

When the 16mm frame had been prepared, the first step in the test was to put it in a projector and adjust the film-chain controls so that it was reproduced in the usual manner. Next, the oscilloscope was connected to the output of the chain, and the picture monitor was connected to the output of the oscilloscope. Care was taken to adjust gain and blanking so that there was no evidence of compression in the signal beyond that which is introduced by curvature at the black end of the transfer characteristic curve. The oscilloscope was next adjusted, using a low time-base speed to produce one complete field on the face of the cathode-ray tube. Six horizontal lines were, of course, evident. Vertical gain of the oscilloscope was set for full-scale deflection in order that maximum accuracy might be obtained, and the lines were traced lightly with grease pencil across the face of the oscilloscope. Readings taken previously from the Eastman Type 1A Densitometer were then recorded on the edge of the oscilloscope scale. By interpolation, five more "density" lines were drawn on the scale, one between each pair of the known readings, giving a total of eleven directly identifiable calibration markings on the face of the oscilloscope.

Since the oscilloscope employed was not d-c restored, it was necessary to have, in addition, a reference black line to ensure proper position on the scale. This twelfth line was produced by scanning a small part of the opaque border of the holder of the frame.

Once the system had been adjusted in this manner, no further movement of the controls was permitted except of the controls affecting phase and time-base speed and, if necessary, of the vertical centering control on the oscilloscope, in order to return the reference black line to the proper position on the scale.

Next, the frame to be measured was substituted for the calibrated frame. Voltages produced by this frame appeared on the monitor. The vertical centering control on the oscilloscope (where the voltages also were presented, of course) was adjusted to ensure coincidence of the black reference lines on the oscilloscope and scale. Since one complete field (as stated above) was under observation, the entire frame was read at a glance, and peak blacks and peak whites were clearly visible in relation to the density scale on the face of the oscillo-

scope tube. An experienced observer is able to read relatively small areas of the film even from this presentation.

It will be recalled at this point that the oscilloscope had a variable-speed time base. To observe smaller portions of the frame, it was necessary only to increase the speed of the oscilloscope timebase as desired — preferably to where a single-line display was visible on the oscilloscope. This single line of scan was, of course, one of the 525 making up the picture. Therefore it followed that the vertical dimension under observation was about 1/500 of frame height, or that fraction of 290 mils, or about 0.6 mil. In the horizontal direction, the lefthand side of the oscilloscope was the left side of the picture. The Tektronix Model 524-D has a transparent faceplate which makes it possible to divide the one line into about 100 parts with fair accuracy. A 16-mm frame is 410 mils wide, so observation of 4.1 mils is practical. Still higher time-base speeds were tried, but accuracy of the system became suspect beyond the single-line display, owing to frequency response of the system and instability in the oscilloscope.

How did we know which of the 525 lines we were looking at? It will be recalled that on the rear of the 524-D oscilloscope is a coaxial connection which is extended to drive the picture monitor. Circuits in the oscilloscope are arranged so that while all video information is fed to the picture monitor in a normal manner, any information that appears on the face of the oscilloscope is brilliance-modulated on the face of the picture monitor. In the full-frame presentation, the picture monitor is entirely brilliance-modulated. As the time-base speed is increased, fewer and fewer lines are brilliance-modulated until the point is reached where a single-line display appears on the oscilloscope and one line is brilliance-modulated on the face of the picture monitor.

Further, the 524-D has a phase-shift network built into the unit. By adjusting this control, the horizontal brilliance-modulated line on the face of the picture monitor will be seen to slide up and down on the frame. The operator may merely adjust the oscilloscope phase control until the line on the picture monitor crosses the area to be measured. It is the line then in evidence on the face of the oscilloscope, and the densities can be read directly from the scale.

Accuracy of the System

To test the system, slides were prepared in the 16mm size with measurable areas on them, i.e., measurable on the Eastman Type 1A Densitometer in the conventional manner. These slides were run through the system as unknowns, and the results compared with figures obtained directly from the densitometer. Disagreement was limited to ± 0.1 except in the densities above 1.75, where the magnitude of error increased rapidly with increase in density. This increase was unquestionably due to the shape of the transfer characteristic curve of the vidicon. If a unit were designed specifically for this purpose, a "black stretch" circuit would increase accuracy. Higher light levels in the projector appear to decrease the error also.

It is important to note that the frequency response of the film-reproducing system and the oscilloscope is a prime determinant in the matter of the size of the smallest observable area. The equipment used in this test was adjusted in each case to the maximum capability. One can see that if a fine-detail area corresponds to a high frequency which is down by 6 db, the magnitude of error on the oscilloscope reading may reach 50%; therefore, the system is accurate only to the limit of the frequency response of the poorest unit in the system. For practical purposes, however, a system that is flat to 5 mc will give accurate readings to the equivalent of about 400 lines of picture information.

Undoubtedly a superior system would employ a flying-spot scanner. Problems of compression would be greatly reduced, an even illumination of the slide would be assured and, perhaps most important from the standpoint of convenience, a film could be stopped and started without recalibrating the system. In the vidicon this could not be done because if the system was set up under static conditions, with the projection lamp of the projector at full brilliance, the film was destroyed by heat. The difference between a short application time when running and a 100% application time when static made the readings meaningless. This latter fault was overcome by running a loop of calibrated material in the projector previous to measuring a piece of film. This works all right, but does not offer the convenience that would be available by employing a flying-spot scanner, which would permit either static or dynamic measurement without recalibration. This system should be explored further.

Since this is a purely comparative method, the calibrated slide is treated in precisely the same manner as the slide (or film) to be measured. This eliminates many chances of error. In the final analysis, the primary purpose of this type of measurement is to determine whether or not a piece of film is suitable for use in the television system. It seems logical to conclude, then, that the best way to prove the point is to make measurements on the film while it is in the type of equipment that will eventually make use of it.

Simplification and Standards Possibilities

Earlier in this paper the word "inexpensive" was used to describe the system. This is true in the sense that all television stations have the equipment capable of making these measurements, save for the calibrated film. As a matter of fact, the system can be simplified for rapid survey. Calibration of the oscilloscope on the film-chain master monitor in the manner described for the 524-D works well enough to determine peak densities. Beyond the use of calibrated film and oscilloscope scale, no special setup of equipment is required.

Since it would be possible to produce a standard 16mm calibrated film in one's laboratory, and since the method is a purely comparative one, it may be surmised that this approach to density measurement might bring about a closer degree of interpretation of future standards than has heretofore been evidenced. Anything said herein about 16mm will work equally well for 35mm and should be a boon in producing slides of constant density limits.

Ideally, standard leader would contain calibrated information, thus serving the dual purpose of checking the grayscale rendition of the film chain as well as giving everyone a density measurement standard. The specific make-up of this leader would, of course, be a matter for the Society to determine.

This general method of determining density is by no means completely explored. Much work remains to be done. And although it is doubtful that this method — or a derivation of it — will ever be sufficiently accurate to replace existing laboratory practices, the speed with which good approximations may be made offers the producer of films and television recordings, and the television station, advantages worthy of consideration.

An Improved Professional 16mm Reversal Camera Film

By N. H. GROET, M. LIBERMAN and F. RICHEY

A 16mm subtractive reversal film with incorporated color couplers, designed to provide high-quality originals for the production of release prints, is described. From these camera originals, release prints onto Eastman Reversal Color Print Film, Type 5269, or release prints by way of Eastman Color Internegative Film, Type 7270, printed onto Eastman Color Print Film, Type 7382, can be produced. The film structure, sensitometric characteristics, exposure requirements, suggested filters and printing behavior of the new film are described.

The production of professional-quality 16mm color motion pictures for educational, training, advertising and entertainment purposes was at first a by-product of the introduction in 1935 of practical color films for home movies. In the late 30's, professional use of the amateur films had caught on to such an extent that special-purpose print films were supplied in bulk form to make better and lower-cost prints from such originals. The availability of these materials gave impetus to the growth of the 16mm branch of the motion-picture industry.

As the producer of commercial 16mm films became more familiar with these materials, he found that the camera film designed for the amateur did not meet his requirements with respect to tone reproduction. For his purposes, the professional needed a camera film with characteristics designed to produce a large number of prints onto another film; good projection quality, essential for amateur films, was not a requirement. The processing service offered for the amateur film also posed a problem for the professional photographer. In order to keep the time schedule for a production to a minimum, the professional also found that it would be economically desirable to be able to process his own originals or to have the close cooperation of laboratories which could perform this service for him.

In view of the requirements for professional 16mm camera films as contrasted with amateur camera films, a modified film and process were made available to the professional cinematographer in 1947. This film, Kodachrome Commercial Safety Color Film, Type 5268, was designed to solve some of the professional's problems and has been used by many producers of 16mm film.

A system in general use for the production of 16mm motion-picture films involves the use of Kodachrome Commercial Film, Type 5268, in conjunction with a reversal duplicating material such as Eastman Reversal Color Print Film, Type 5269. When rush prints or a limited number of release prints are needed, these prints are made directly from the camera original. For lap dissolves and other effects, A&B roll printing is usually employed. In cases requiring high-volume release printing, and in the interest of protecting the "camera original," an intermediate reversal printing master is often prepared on the duplicating film; final prints are made by printing the intermediate printing master onto Eastman Reversal Color Print Film, Type 5269. These printing methods are shown schematically in Fig. 1.

Another possible method for the production of prints was presented to the Society in April, 1956, by Zwick, Bello and Osborne.[1] This system employs an intermediate color negative on Eastman Color Internegative Film, Type 7270, and is shown schematically in Fig. 2. Release prints are made by printing this intermediate negative onto a positive color film such as Eastman Color Print Film, Type 7382. It is also possible to prepare a 35mm internegative on Eastman Color Internegative Film, Type 5270, and a release print for theater use on Eastman Color Print Film, Type 5382.

Subsequent to the introduction of Kodachrome Commercial Film, Type 5268, improved photographic emulsions, new couplers for the production of dye images, and new processing formulas have made possible the introduction at this time of an improved color camera film for the professional 16mm cinematographer. This film is Ektachrome Commercial Film, Type 7255. In designing this film, emphasis has been placed on obtaining improved speed, graininess, sharpness, latitude, curve shape and color quality.

This paper describes the new camera film which can be used in place of the Kodachrome Commercial Film in the duplicating systems as just outlined.

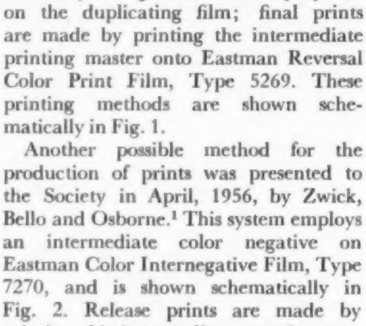


Fig. 1. A professional 16mm color-film duplicating system.

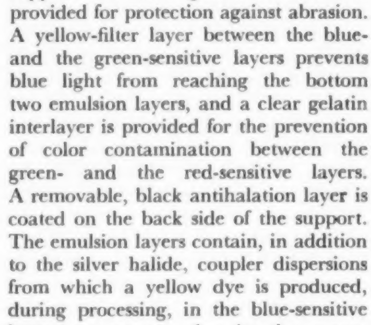


Fig. 2. A professional color-film duplicating system.

General Description

Ektachrome Commercial Film, Type 7255, is a multilayer, three-color subtractive film, with incorporated dye-forming couplers. The structure is shown schematically in Fig. 3. The three-color records are provided by emulsion layers sensitized to blue, green and red light, respectively, coated on a safety-film support. A clear gelatin overcoat is provided for protection against abrasion. A yellow-filter layer between the blue- and the green-sensitive layers prevents blue light from reaching the bottom two emulsion layers, and a clear gelatin interlayer is provided for the prevention of color contamination between the green- and the red-sensitive layers. A removable, black antihalation layer is coated on the back side of the support. The emulsion layers contain, in addition to the silver halide, coupler dispersions from which a yellow dye is produced, during processing, in the blue-sensitive layer, a magenta dye in the green-sensitive layer and cyan dye in the red-sensitive layer. The proper choice of developing agent and of the three color-forming couplers results in dye-absorption curves shown in Fig. 4, where density is plotted against wavelength; for reference, the Kodachrome Commercial, Type 5268, dyes are shown in dashed lines. The reduction in the unwanted absorptions of the dyes in the new film is one of the important factors

Communication No. 1981 from the Kodak Research Laboratories, presented on April 23, 1958, at the Society's Convention in Los Angeles by N. H. Groet, M. Liberman and F. Richey (who read the paper), Research Laboratories, Eastman Kodak Co., Rochester 4, N.Y.

(This paper was received on August 27, 1958.)

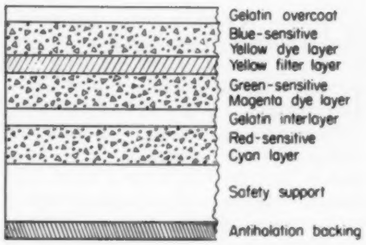


Fig. 3. Schematic cross section of Ektachrome Commercial Film, Type 7255.

contributing to the improved color reproduction.

Film Characteristics

Ektachrome Commercial Film, Type 7255, is a medium-speed, fine-grain, long-latitude, color reversal film balanced for 3200 K illumination as commonly used in the industry. The characteristic curves for the reproduction of a scale of neutrals are shown in Fig. 5. The three curves represent the densities of the neutral scale to red, green and blue light, as plotted against relative log exposure, and were measured on the Eastman Electronic Densitometer, Type 31A, with Eastman Status K Filters. The Eastman Status K Filters very nearly predict the printing densities of the camera film to Eastman Reversal Color Print Film, Type 5269. Low contrast scales of approximately 1.10 gamma with uniformly long straight-line characteristic curves are obtained.

The emulsions are coated on a safety support with good dimensional stability. The film is perforated according to American Standard PH22.5-1953, except dimension B, which is 0.2994 in., and dimension L, which is 29.94 in. The antihalation backing of this film is of the same type as that used with Eastman Color Negative and Eastman Color Print films and requires the same care in removal.

The individual emulsion layers of the new film have keeping properties similar to those of other multilayer camera films. For extended periods of storage, the unexposed film should be kept at a temperature not exceeding 55 F, in order to minimize color-balance changes. Latent-image keeping properties are also similar to those of other color camera films and it is desirable to process film as soon as possible after exposure.

Although materials such as Ektachrome Commercial Film do not have colored couplers for color-correction purposes, the interimage effects which occur in such reversal materials contribute to improved color quality. To illustrate one such effect, the solid H&D curve in Fig. 6 shows the amounts of magenta dye present in the neutral scale. The density of magenta dye is

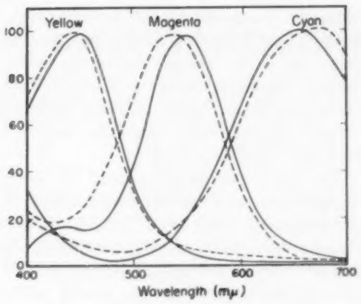


Fig. 4. Spectrophotometric curves of Ektachrome (solid lines) and Kodachrome (dashed lines) dyes.

expressed in equivalent neutral density units plotted against log exposure. As the blue exposure is decreased to the point where the scale receives no blue exposure, yellow dye (shown as blue density by the horizontal dashed line) is added; a decrease in magenta dye is evident, as shown by the dashed-line H&D curve. As cyan dye is added by decreasing the red exposure (shown as red density by horizontal dotted line), a further decrease in magenta dye, as shown by the dotted H&D curve, is observed.

Green colors are generally reproduced too dark as a result of the unwanted green absorption of the cyan and yellow dyes produced in color films. The reduction in magenta dye as a function of decreasing blue and red exposures has the net effect of compensating for the unwanted absorption of the yellow and cyan dyes and improves the brightness of green colors in the final reproduction.

Exposure of Film

Ektachrome Commercial Film is furnished in standard lengths for use in conventional 16mm motion-picture cameras. The film has an exposure index of 25 to tungsten, 3200 K illumination, and an index of 16 when filtered with a Kodak Wratten Filter No. 85 for daylight. Compared with Kodachrome Commercial Film, the film speed is more than double; in spite of the higher speed, prints from the Ektachrome Commercial are finer-grained and sharper compared with prints made from its predecessor.

Suggested filters for use in exposing the new film are shown in Table I.

Kodak Color Compensating Filters may also be used to correct for slight color-balance differences from one emulsion to another. This practice will minimize the changes required in the printer filter pack when the original consists of footages from different emulsion numbers. When a particular emulsion requires a compensating filter, only one filter will be necessary, and

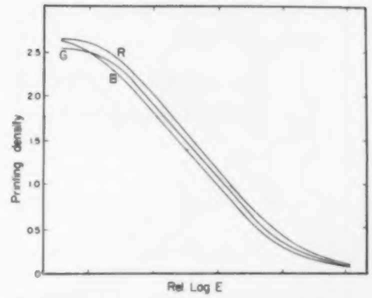


Fig. 5. Characteristic curves of Ektachrome Commercial Film, Type 7255. Densitometer: Eastman Electronic Color Densitometer, Type 31A, Status K Filters, which read printing density.

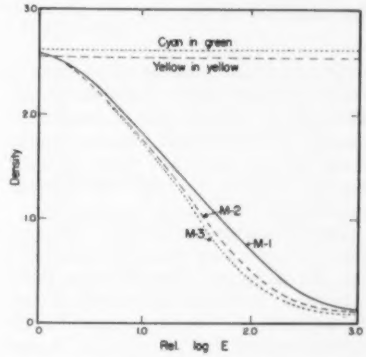


Fig. 6. Interimage effect in magenta layer of Ektachrome Commercial Film, Type 7255, as a function of exposure in yellow and cyan layers: M-1, Magenta in neutral; M-2, Magenta in yellow; M-3, Magenta in green.

this filter will be a 0.10 cyan, a 0.10 magenta or a 0.10 yellow. The appropriate filter for a particular emulsion will be indicated on the side of the film carton directly below the emulsion number.

Table I. Filters Required With Various Light Sources for Exposure of Ektachrome Commercial Film, Type 7255.

Light source	Light source filter required	Camera filter required
3200 K Tungsten lamps or "CP" lamps (approx. 3350 K)	None	None
Daylight (sunlight plus some skylight)	None	Kodak Wratten No. 85
M-R Type 170, 150-amp, high-intensity arc	Straw-colored gelatin filter such as Brigham Y-1	Kodak Wratten No. 85
M-R Type 40, 40-amp Duarc	Florentine Glass	Kodak Wratten No. 85
Daylight	None	Kodak Wratten No. 85

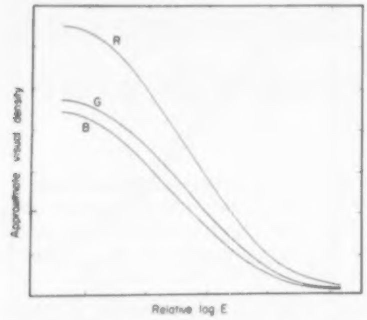


Fig. 7. Characteristic curves of Ektachrome Commercial Film, Type 7255. Densitometer: Eastman Electronic Color Densitometer, Type 31A, with filters which approximate the appearance of this sensitometric exposure to the dye.

These exposure ratings and suggested filters are intended as a guide for the user. Each cameraman is urged to determine the optimum exposure conditions for any new film with his own exposure meter, camera and lighting equipment.

Set-lighting conditions for the new film are similar to those recommended for Kodachrome Commercial Film. The ratio of fill light to key light should be adjusted to 1:2 or 1:3 and should seldom exceed 1:4, except for special effects.

Choice of Colors for Costumes, Make-up, Set Properties, Artwork, etc.

Before actual production is started, it is desirable to make careful tests of various pigments, fabrics, make-up materials, etc., and to determine how these colors will be reproduced in the final print film, in the complete process intended for production. The results of these tests should be carefully evaluated and catalogued for future reference.

Printing Ektachrome Commercial Film

Ektachrome Commercial Film may be printed on either reversal color-print films or Eastman Color Internegative Film, Type 7270. The film is designed to print at very nearly the same filter balance in the printer as Kodachrome Commercial so that existing library footage of the latter may be intercut with the new film if desired.

An important point should be considered here. Inspection of Fig. 5 demonstrates that the new film has equal red, green and blue contrasts when measured through filters which give values approximating actual printing densities. However, if the same dye scale is measured with filters which approximate the appearance of this sensitometric exposure to the eye, a high red density and contrast are seen, and the user would rightly conclude that the original itself would not be optimally balanced with respect to a visual match for the original silver step tablet (Fig. 7). This film is not suitable for direct projection and should not be judged on that basis, but rather, on the quality of the prints made from the camera original.

As a result of the discrepancy between visual and printing densities of Ektachrome Commercial Film, intercut Ektachrome and Kodachrome camera originals which print at the same printer balance will differ markedly in visual appearance. The Ektachrome camera original will appear cyan in balance by visual inspection as compared with the Kodachrome camera original.

Care of Film

Good practices of housekeeping in processing, editing and printing rooms, careful film-handling procedures and proper maintenance of printing equipment are essential for the production of satisfactory originals on Ektachrome Commercial Film. The incorporation of coupler dispersions softens the emulsion layers and this is detectable in the raw film stock and also in the processed film. Although this film has improved abrasion-resistance over other motion-picture films containing coupler dispersions, it is slightly more susceptible to scratching than the Kodachrome film previously used. Careless handling will damage originals on Ektachrome Commercial Film.

Films may be cleaned by a detergent washing process described before this Society in May, 1956 by Turner and Jensen.[2] Other special film-cleaning techniques and film-cleaning solvents should be tested before they are applied to valuable originals.

Sensitometric Exposures

Reproducible sensitometric strip exposures are required as a convenient monitor of film and process variations which aid in process control.[3] These exposures may be made on Ektachrome Commercial Film on any reliable sensitometer providing tungsten-quality illumination of approximately 3200 K color temperature. An exposure time of $\frac{1}{25}$ or $\frac{1}{50}$ sec is used to approximate the exposure time given in the camera. Slight variations in contrasts and in relative speeds of the three emulsion layers will result from either very long or very short exposure times.

Processing

At the Society's Convention the processing of Ektachrome Commercial Film, Type 7255, was covered in a companion paper by D. S. Thomas, H. Rees and H. Vogt of the Color Technology Division of Eastman Kodak Co. That paper will not be published in the *Journal;* manuals and other instructions for processing this film are available from the Eastman Kodak Co., Motion Picture Film Department.

References

1. D. M. Zwick, H. J. Bello and C. E. Osborne, "A 16mm color internegative film for use in color motion-picture photography," *Jour. SMPTE, 65:* 426–428, Aug. 1956.
2. J. R. Turner and E. W. Jensen, "Some principles of spray processing," *Jour. SMPTE, 65:* 92–96, Feb. 1956.
3. A. M. Koerner, "The problems of control of color photographic processes," *Jour. SMPTE, 63:* 225–230, Dec. 1954.

A Two-Speed Drive for Continuous Motion-Picture Printers

By JOHN J. GRAHAM
and HOWARD F. OTT

In this two-speed drive, adapted to a Bell & Howell Printer, Model D, two motors running continuously drive the fields of two electric clutches in the same direction, one at approximately twice the speed of the other. The armatures of the clutches are on the same shaft and are splined to the hub of a third pulley that drives the printer. An electrical circuit triggered by a cuing system activates one clutch or the other to change the speed of the printer within a short enough interval so that there is no loss in projection quality of the print. Such a speed changer permits optimum productivity on a printer using negatives containing scenes of widely varying densities.

The motion-picture printing laboratory must produce release prints of high quality as quickly as possible. The laboratories, however, are required to print conformed (or "cut") negatives. Such negatives often require timing corrections that are difficult to make because of the limited exposure range of the printer. This problem, although acute with color, also exists with black-and-white.

Usually the speed at which a printer is operated is determined by the exposure required to produce quality prints from a well-exposed negative. However, some method is always provided for changing the exposure to compensate for minor density variations because of camera exposure, and film and process variability. This compensator is usually designed to permit timing changes of 0.6 to 0.8 ($\pm$0.3 to 0.4) in log exposure. Conformed negatives containing sections requiring changes greater than this amount present a special problem to the printing laboratory. Duplicate negatives incorporating the special-effects usually have a higher density than the original negative, if optimum reproduction is to be obtained. If the exposure latitude of the printer is used to compensate for scene-to-scene variation in the original sections, another means of increasing exposure is needed to compensate for the overall increased density of the duplicate or of any sections having higher than normal density.

Several techniques are being used to obtain the increased exposure. One is to increase the light intensity of the printing lamp by increasing the applied voltage. With this method the normal speed of the printer is maintained, and neutral density filters are inserted when normal negatives are printed and removed when the denser sections are being exposed. Operating the lamp at more than its rated voltage, however, shortens the lamp life and makes changes in the lamp output more rapid. Another, and perhaps more common method is to reduce the normal printing speed so that all sections of the conformed negative can be accommodated. This, however, approximately doubles the printing time required, although in many instances the conformed negative contains only a small percentage of denser scenes.

It is the purpose of this paper, therefore, to describe a device that extends the timing range of the printer by automatically and quickly changing the operating speed of the printer.

Presented on April 23, 1958, at the Society's Convention in Los Angeles by John J. Graham and Howard F. Ott (who read the paper), Color Technology Div., Eastman Kodak Co., Rochester 4, N.Y.
(This paper was received on September 8, 1958.)

Two-Speed Drive

A two-speed drive was designed and adapted to a Bell & Howell Printer, Model D (Fig. 1). With this drive the increased exposure required for the denser sections of the conformed negative is obtained by decreasing the printer speed, while the regular speed is maintained for the normal sections of the negative.

Figure 2 is a close-up of the speed changer. The layout of the parts of the speed changer is shown in Fig. 3. Two electric clutches are mounted on the same shaft. A separate pulley is fastened rigidly to the field, or driving member, of each clutch. Between the fields with their driving pulleys is a third pulley that drives the printer.

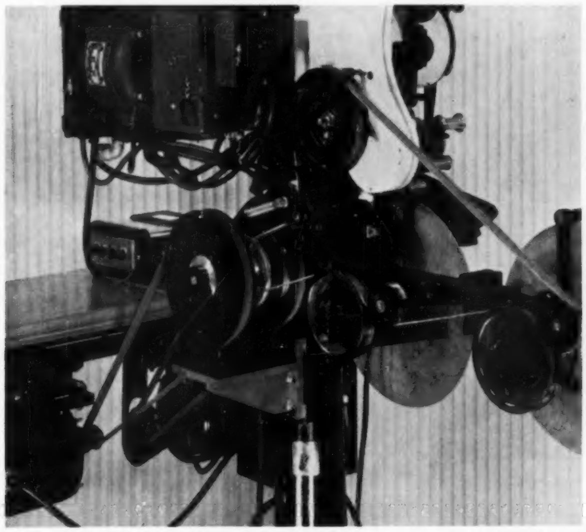


Fig. 1. The two-speed drive installed on a Bell & Howell Printer, Model D.

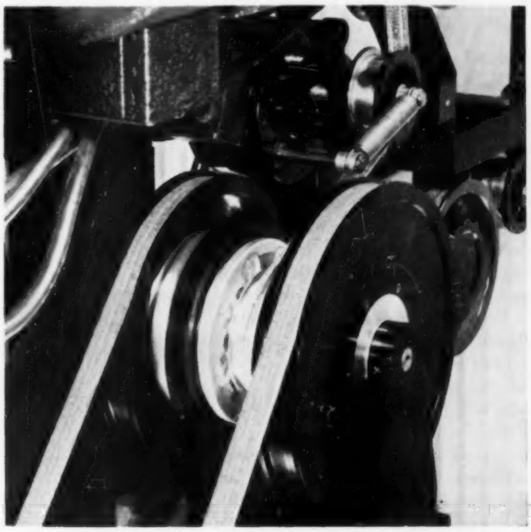


Fig. 2. Close-up of the speed changer.

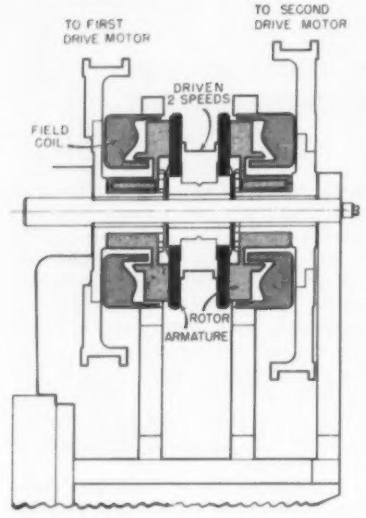


Fig. 3. Layout of the parts of the speed changer.

The armatures of both electric clutches are splined to the hub of this center pulley. Only one clutch or the other is engaged at a time. The armature of the unactivated clutch floats with clearance between the center pulley and its field. Two motors drive the two outer pulleys continuously in the same direction but at different speeds. One speed is chosen to be suitable for printing negatives having normal density, and the slower speed is suitable for printing the denser duplicate-negative sections. The speeds are determined by the diameters of the pulleys selected for use on the clutch fields and on the motors. This arrangement of the mechanical parts of the drive reduces inertia to a minimum and makes for maximum smoothness and rapidity of the speed change.

Cuing

Any cuing system currently used by a laboratory could be adapted for use with this speed changer. An electric circuit, triggered by the cuing system, activates alternately one clutch or the other. A diagram of the circuit which was used is shown in Fig. 4. The rectifier shown within the dotted circle is a plug-in unit supplied by the manufacturer of the clutches.

When the speed changer was first installed on the printer, the operating speeds were 30 and 60 ft/min. A variation of the standard notching system was selected for cuing because it involved little change in the techniques already in use in our laboratory. This variation consisted of making notches of two different depths in the edge of the film. A notch slightly shallower than the standard depth is used for intensity and color timing. A slightly deeper notch activates the speed-changing mechanism as well. Two sensitive switches are controlled by the edge-detecting roller. For a shallow or timing notch, only one switch operates; in the deeper notch, both switches operate. This arrangement takes into account that negative changes necessitating speed changes for printing almost always involve some color and density correction. At the film speeds involved in this installation, the distance along the film in which the film was either accelerated to 60 ft/min or decelerated to 30 ft/min was about $\frac{1}{4}$ in. With the speed transition taking place in such a small area of film, it was entirely satisfactory and in fact desirable that cuing of both timing and speed be simultaneous.

After the preliminary tests at 30 and 60 ft/min, the operating speeds were increased by changing motor pulleys, to see whether there might be limitations to the system when operated at higher film speeds. For the change from 60 to 120 ft/min or 120 to 60 ft/min, the distance along the film over which the change takes place is approximately one frame. For the change from 100 to 200 ft/min or 200 to 100 ft/min, it is approximately three frames. Consider the change from 100 to 200 ft/min. The denser negative precedes the change. If the printer starts accelerating on cue at the splice, the print will have a frame or two noticeably darker than the adjacent frames before fading into the same density level. If the change is now reversed, for instance 200 to 100 ft/min, and the printer starts decelerating at the splice, the print will have a frame or two a little lighter than the adjacent frames as it fades into the same density as the adjacent areas.

In order for the change not to be noticeable upon projection, it is desirable that the transition frames average the same density as the adjacent frames. By the simple expedient of starting the change before the splice, the affected area can be an over-print of the thinner negative adjacent to an under-print of the denser negative, resulting in a transition difficult to detect on the screen. Separate cuing is

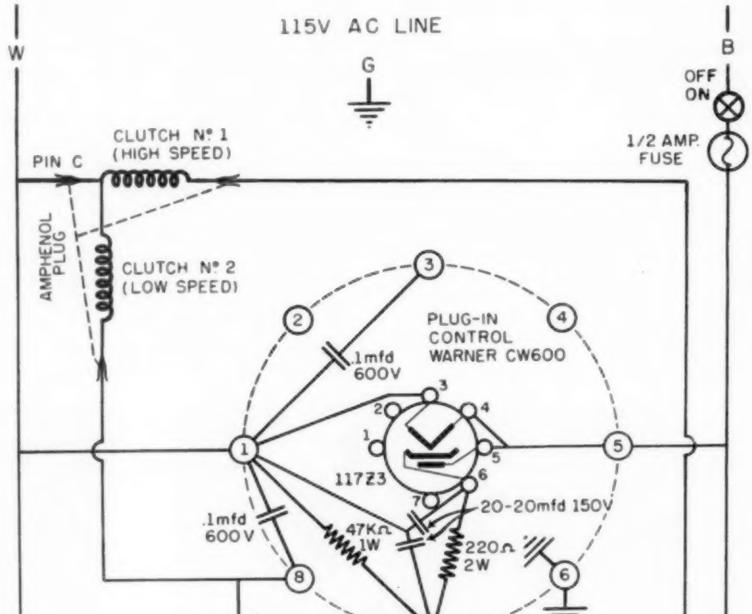


Fig. 4. The electrical circuit of the two-speed drive.

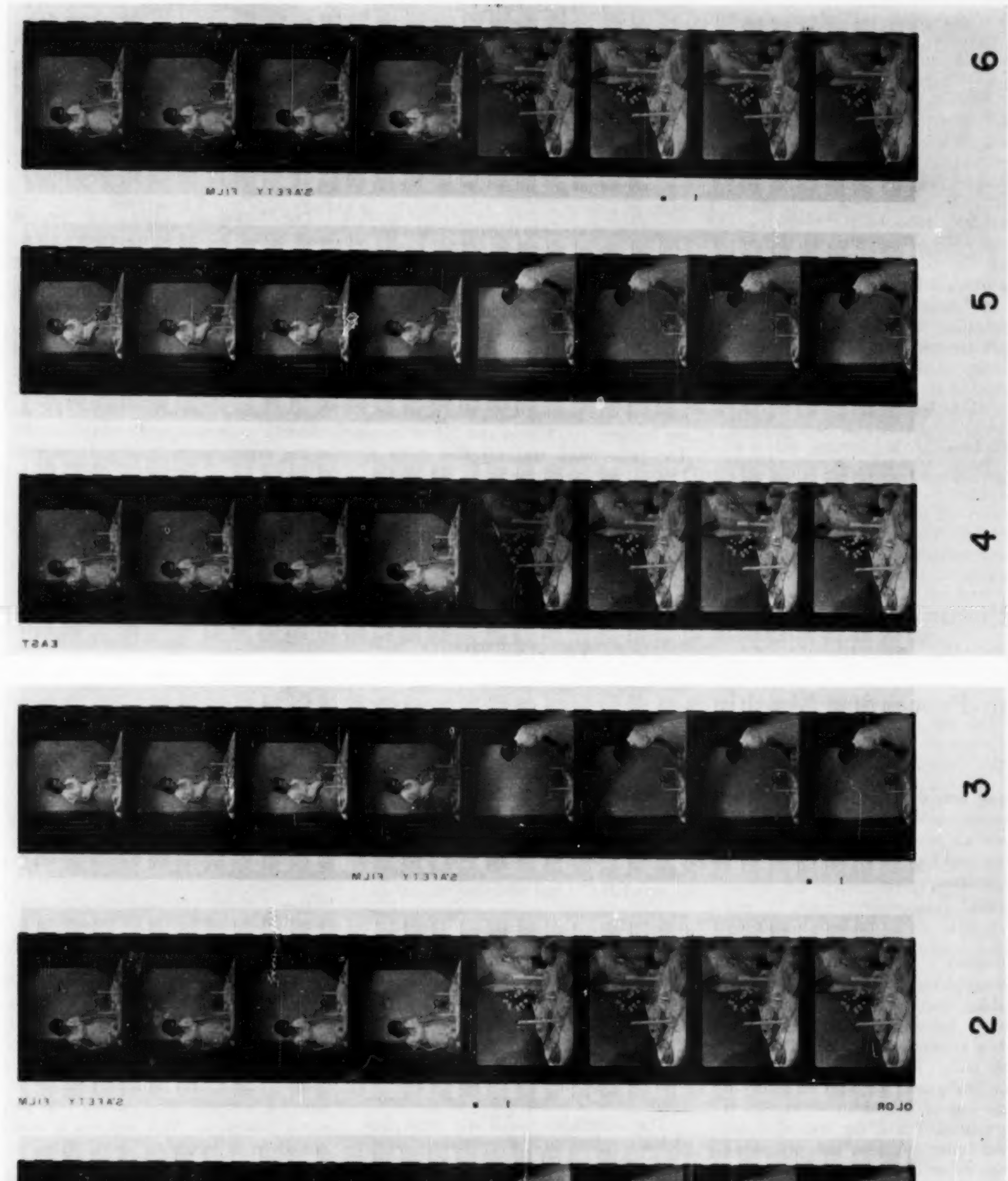


Fig. 5 Prints indicating the extent of the affected area at the speed change: top to bottom (1) 100 to 200 ft/min; (2) 200 to 100 ft/min; (3) 60 to 120 ft/min; (4) 120 to 60 ft/min; (5) 30 to 60 ft/min; (6) 60 to 30 ft/min.

therefore desirable at these higher operating speeds.

In order to initiate the speed change ahead of the splice and ahead of the color and intensity timing, the printer was altered so that conductive patch cuing could be used for the speed change while retaining notch cuing for the intensity and color timing. For this, the negative tension roller on the printer was replaced by a split and electrically insulated roller. The area selected for application of patches was the area between the perforations and the edge of the film on the side opposite the notches.

The patch detector is one used previously by Lovick, Seemann and Stott.* The patch on the edge of the negative grounds the grid of a 6J5 tube. A sensitive relay in the plate circuit actuates the stepping relay of the speed-changer control (Fig. 4).

* R. C. Lovick, J. M. Seemann and J. G. Stott, "Scene-change cuing in motion-picture printing," *Jour. SMPTE, 65:* 594–598, Nov. 1956.

Performance

Prints were made on Eastman Color Print Film, Type 5382, with speed changes from 30 to 60 ft/min, from 60 to 120 ft/min, and from 100 to 200 ft/min. The reverse changes were also made. It was judged that none of these changes were noticeable on projection. Figure 5 shows black-and-white reproductions of actual frames taken from the speed-change areas for each condition.

Tests were made to determine whether perforations of negative or print stock might be damaged by the accelerations to the higher film speeds. A 100-ft negative was cued for speed changes at 10-ft intervals and wound on the outside of a 1000-ft roll. This way the perforations were subjected to the maximum stress on acceleration. The negative was printed 426 times, alternating between 100 ft/min and 200 ft/min. The print stock was supplied from a 1000-ft roll and rewound. No shock-absorbing rollers were used. The negative showed no damage directly attributable to the accelerations or decelerations. Also, no damage to perforations of the print stock was detectable. On a permanent installation, however, at high printer speeds it would undoubtedly be good insurance to use a shock-absorbing roller between the negative supply and the first feed roll.

Conclusion

The two-speed drive has proved itself useful in many instances in our laboratory. Besides its use with conformed negatives containing original negatives interspersed with duplicate negatives, it is often useful where extreme ranges are encountered within the original negative, and for easy change where it is desired to print negatives at other-than-standard speeds. There is no evidence that the quick-change feature of the drive results in any damage to negatives being printed.

A Pneumatically Operated Film-End Detector and Film Brake for Continuous Motion-Picture Film-Processing Machines

By T. J. LAWLOR

Film-end detectors and film brakes are used on high-speed motion-picture film-processing machines to sense the end of a film roll automatically and hold the film end while a new roll is being spliced onto it. A pneumatically operated film-end detector and film brake have been developed which offer advantages over previous designs.

Introduction

Motion-picture films, both black-and-white and color, are commonly processed on machines in which the film is a continuous strand following a helical path. These machines employ a film brake and an end detector to prevent loss of thread-up when film is being spliced. When the end of a roll of film being fed into the processing machine passes through the end detector, the film brake is applied. Experience with film-end detectors which depend upon film thickness for actuation has shown them to be unreliable in operation and a cause of film damage. This type of detector senses the presence of film by the displacement of two metal rollers between which the film passes. The adjustment of these rollers is very critical. Slight vibrations occasionally cause actuation of the film brake; furthermore, individual detector rolls must be employed for each width of film.

The objections which are most frequently raised to the commonly used, solenoid-operated film brake are its high initial and maintenance costs and the noise of the solenoid itself.

With an aim toward overcoming these difficulties, a pneumatic film-end detector and film brake have been developed. Both these devices were designed so as to avoid major electrical changes on processing machines. They can be used with all sizes of motion-picture film. Figure 1 is a schematic diagram of the pneumatic end-detector and film-brake system.

Presented on October 19, 1958, at the Society's Convention at Detroit by T. J. Lawlor, Film Testing Division, Eastman Kodak Co., Kodak Park, Rochester 4, N. Y.
(Paper first received on May 29, 1958, and in its present form on September 22, 1958.)

The End Detector

The pneumatic film-end detector consists of two separate assemblies — a film-guide assembly and a pressure-switch assembly. The film-guide assembly (Fig. 2) is mounted in the film path near the supply spindle of the processing machine. Its operation is as follows: A jet of low-pressure air (3 to 6 psi) is directed downward from an orifice* in the common axle of the two-part roller. This roller consists of two matched parts, each stepped to accommodate three film widths between them — 16mm, 32mm and 35mm. The air jet enters a receptor tube mounted in the metal baseplate. This receptor is connected by a length of $\frac{1}{4}$-in. diameter tubing to the pressure-switch assembly.

The pressure-switch assembly consists of a needle valve, an air accumulator and a sensitive pressure switch.† The needle valve and the accumulator together form an adjustable time delay which provides a lag in the actuation of the switch.

* Orifice size is No. 70 drill hole.

† Pressure switch: Cook Electric Co. Low-pressure switch: Catalog No. 555-903 may be used or G. M. Simmons Co. Catalog No. 44526B may be substituted.

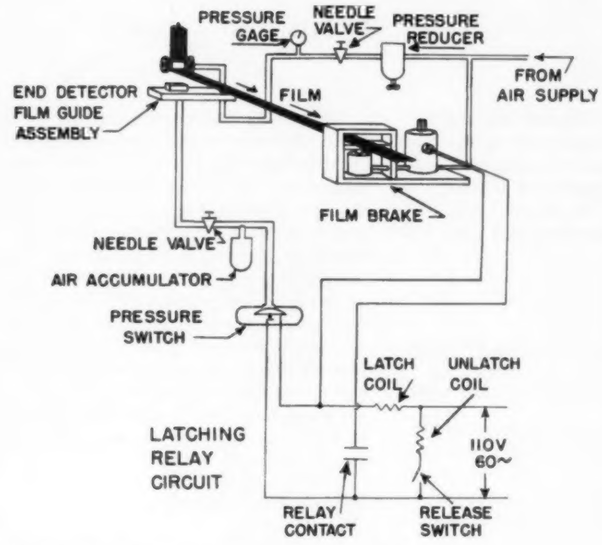


Fig. 1. Pneumatic end-detector and film-brake system.

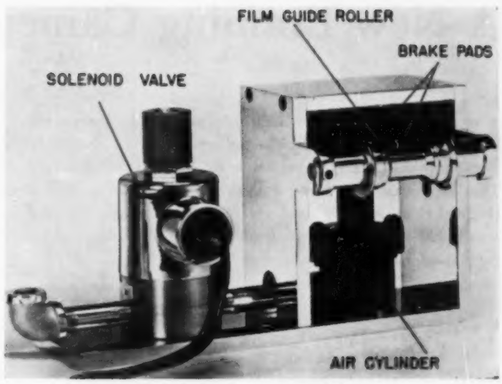


Fig. 3. Film brake.

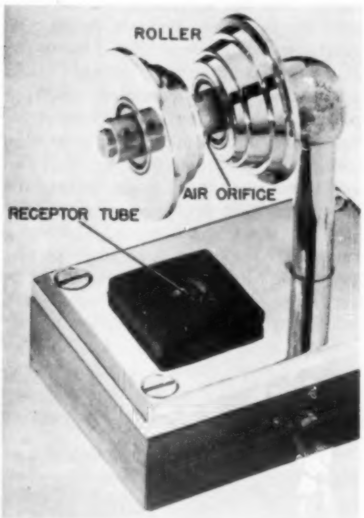


Fig. 2. End-detector film-guide assembly.

As long as the film strand is passing around the detector roller, the air jet is prevented from entering the receptor tube, and no air pressure builds up in the pressure switch. When the film end goes by, air from the jet will enter the receptor and actuate the switch. The time delay prevents actuation of the switch by identifying perforations, in the event that perforations are present, in the picture area of the film. This feature can be eliminated if no such perforations are encountered.

The Film Brake

Figure 3 shows the pneumatic film brake. It is small in size — 6 in. long by 4 in. high by 2 in. deep — and operates from air pressure of approximately 20 psi. Like the end detector, it may be used without adjustment with any film commonly processed. It is composed of a 3-way solenoid valve,‡ a film guide roller, and a small, commercially available air cylinder§ which compresses two Neoprene brake pads. Because of the large area of the brake pads, the air pressure can be maintained at a low level, thus avoiding film damage.

When the switch in the film-end detector is actuated, the solenoid valve is opened, admitting air to the cylinder. The valve is held open by a latching relay and must be manually released by the operator upon completion of the splice. When the valve is closed, the air cylinder is vented to the atmosphere, enabling the cylinder return spring to separate the brake pads.

Conclusion

Little maintenance will be required with the end detector and brake described, resulting in much less machine down-time because of trouble with the brake and end detector. The units will be found capable of sensing the end of film moving at 160 ft/min and stopping it within 2 in. of travel.

The pneumatic end detector and brake can be built for about a third the cost of former equipment. Installation of these compact units will provide more space for the subsequent splicing operation.

‡ Skinner 3-way solenoid valve V5D-9550 may be used or Versa 3-way solenoid valve VSG 330 may be substituted with some dimensional changes.

§ Mead midget air clamp No. V1 may be used; Schrader 3451A may be substituted with some dimensional changes.

A New Framing Camera

By MILTON C. KURTZ

A continuous writing framing camera, the Beckman & Whitley Model 192, has been designed to retain the advantages of existing framing cameras while incorporating other characteristics to increase the scope and extent of usefulness. The new cameras have a longer writing time and a greater number of frames than earlier models and do not require synchronization with the event being studied. Reasons for construction are explained and design parameters and performance specifications are given.

Because no two individuals, even trained observers, see things identically, direct observation of physical phenomena by individual observers tends to lead to variations in the recording of physical data derived from experiment.

The science of instrumentation has negated these variations to a considerable degree by providing permanent records of certain physical changes caused by an experiment. These records can be analyzed and a consensus of opinion derived from discussion of the results.

In many cases, however, these results are baffling even to the most experienced persons and the consensus of opinion is often influenced by guess or intuition. Obviously, direct visual observation of the experiment itself is desirable so that an accurate description of the events causing the measured physical changes can be understood.

Photography of experimental devices has been used for many years to provide a permanent visual record of experiments which could be examined and reviewed by researchers at their convenience. With events becoming ever faster and interest in rapid rate processes becoming more intense, increasingly severe demands have been made on cameras and photographic processes.

Eventually, technology evolved to the point where single photographs could be taken of any event moving at very high velocities; however, as an observer would see events differently, so individual experiments of apparently identical subjects react differently. This variation led to the development of cameras to record sequential photographs of high-speed phenomena at very short exposures with short time intervals between exposures. These developments progressed in the following directions:

(1) Continuously moving film cameras with compensating devices;

(2) Image dissecting cameras to sample images and record bits of information to be reconstituted before evaluation;

(3) Short duration repetitive flashlamps;

(4) Rotating mirror framing cameras; and

(5) Electronic cameras — pulsed tube.

With the exception of the moving-film cameras with rotating prism compensators, other devices met with little commercial success until again the requirements for observation exceeded the capabilities of the cameras.

An analysis of the high-speed field was made by Beckman & Whitley and, as a solution to the problem, a design was drawn up for a camera with a short exposure (0.04 μsec) high framing rate (4.3 million pictures/sec) and sequential full-frame pictures (25 pictures about 1 in. by $\frac{3}{4}$ in.). Such a camera was welcomed by researchers who needed a high-speed sequential framing camera, but who lacked time, talent or funds to expend on its development. This original camera, the Beckman & Whitley Model 189 Framing Camera (Fig. 1), operates as follows:

Fig. 1. Beckman & Whitley Model 189 Framing Camera.

The subject under study is imaged on the surface of a mirror. The mirror is rotated at high velocities up to 18,000 revolutions/sec. The image is relayed 1 to 1 to a film plane through 25 pairs of relay lenses. Effective shuttering action is obtained by locating a diamond stop just behind the objective lens and projecting an image of this primary stop on a multiple aperture stop plate located between the relay pairs (Fig. 2.) The aperture thus projected is equal in size to the actual apertures on the plate. The spinning mirror scans the primary stop across the secondary stops forming a "between-the-lens shuttering action."

Military Applications

The Model 189 Camera found immediate application in studies of explosives, internal ballistics, and high-intensity electric arc discharges. Because it was mandatory that the subject be synchronized with the event and because the camera must *initiate* the event, the Model 189 Framing Camera was limited in its application. With increasing emphasis placed on high-speed aerodynamics for supersonic flight and missile nose cone studies, it became obvious that an additional instrument to circumvent the synchronization problems, while retaining the short exposure, high framing rate, high resolution and large picture size of the Model 189 Camera, would be very desirable. Therefore, about two years ago a development program was initiated to determine the feasibility of such a camera from a technical viewpoint. The first step was to define and evaluate the required performance

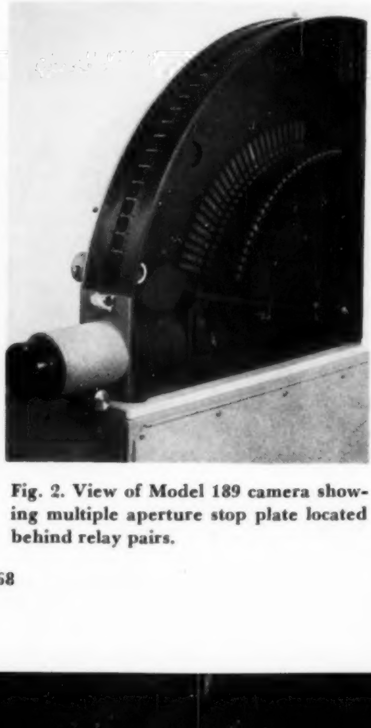


Fig. 2. View of Model 189 camera showing multiple aperture stop plate located behind relay pairs.

Presented on April 22, 1958, at the Society's Convention at Los Angeles by Milton C. Kurtz, Beckman & Whitley, 973 San Carlos Ave., San Carlos, Calif.
(This paper was received on August 14, 1958.)

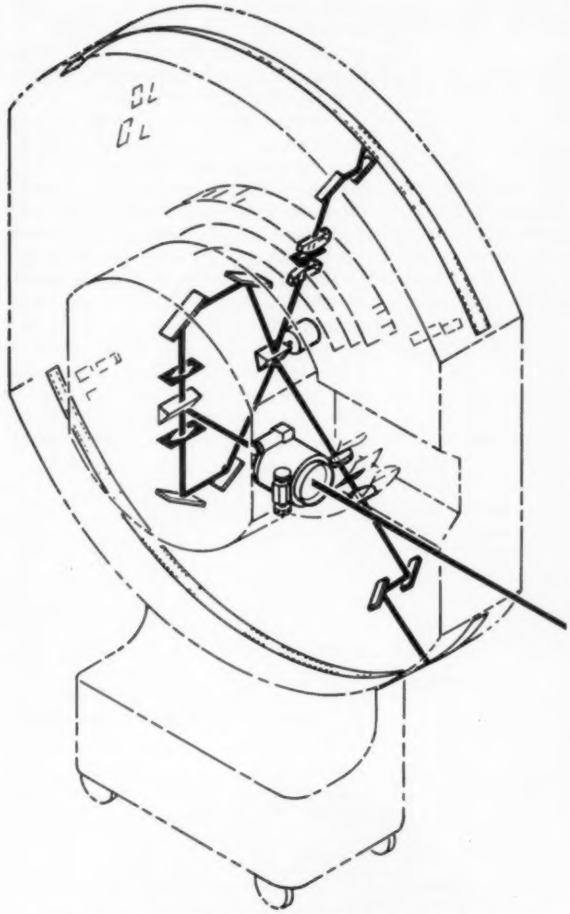


Fig. 3. Schematic of optical system used in new framing camera, Model 192.

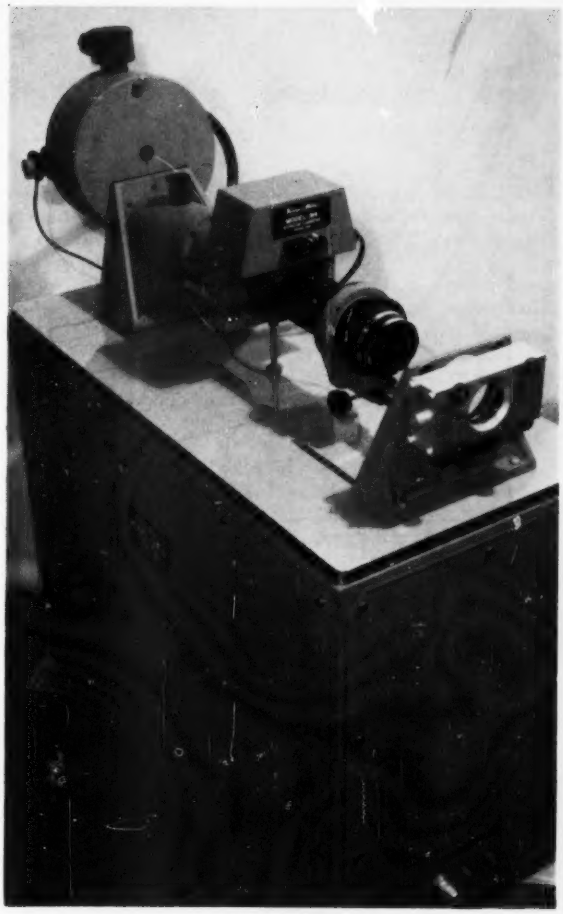


Fig. 4. Blast shutter provided to prevent rewrite.

characteristics and it was decided that the following were both necessary and achievable:

1. Number of frames — 100;
2. Frame size — 17 by 25 mm minimum;
3. Framing rate — 1,600,000;
4. Aperture — Not less than $f/14$ at the film;
5. Resolution — Not less than 40 lines/mm;
6. Optical distortion — Less than 1%;
7. Exposure time — 0.14 to 0.4 m/sec;
8. Writing time — 55 μsec minimum;
9. Should give optimum results when photographing objects moving at Mach 15–20; and
10. Above all, the camera was to be capable of operation without synchronization with the subject under study.

A program was launched to develop working prototype optical systems. The more promising were selected for further study.

All of the systems considered were adaptations of the basic idea incorporated in the original camera.

A thorough analysis of several schemes showed certain mechanical and optical disadvantages in each system; however, one showed promise and was selected for further development. It operates as follows (Fig. 3):

The primary entrance beam is split behind the objective lens after passing through the primary entrance pupil. By means of several relay mirrors, each beam is imaged on different surfaces of a triangular rotating mirror. Each face of the mirror is ground to act as a lens which not only receives the image relayed to it by the mirrors, but also projects an image of the primary entrance pupil to the plane of an exit pupil located between relay lens pairs. The projected primary stop scans the secondary stop plate as the mirror turns and shutters the beam. The relay lenses, arranged in two oppositely and accurately disposed bands of about 120° each, relay the image on the mirror surface to strips of film placed behind the relay lenses. Since there are three mirror faces reflecting beams brought in at 180° apart, when one mirror face is in position to direct the light bundle to the last frame in one bank, the adjacent mirror face is in position to direct the light bundle to the first frame of the opposite bank of lenses and film.

Development of the camera design disclosed the following operational specifications to be realistic.

1. Number of frames — 82; (There was not sufficient space to put in 100 frames.)
2. Frame size — 17 by 25 mm;
3. Frame rate — Up to 1,400,000 pictures/sec;
4. Performance would be optimum at Mach 15–20 with object magnification of 0.1;
5. Aperture — At the film, at $f/26$;
6. Resolution — Dependent on the film used but between 20–24 lines/mm minimum;
7. Optical distortion — Less than 1%;
8. Exposure time — 0.1 μsec;
9. Writing time — 55 μsec.

One matter to mention in passing, and not to be taken lightly, is the problem of rewrite or double exposure. Note that the camera will take 82 pictures in a period of 55 μsec. If the event under

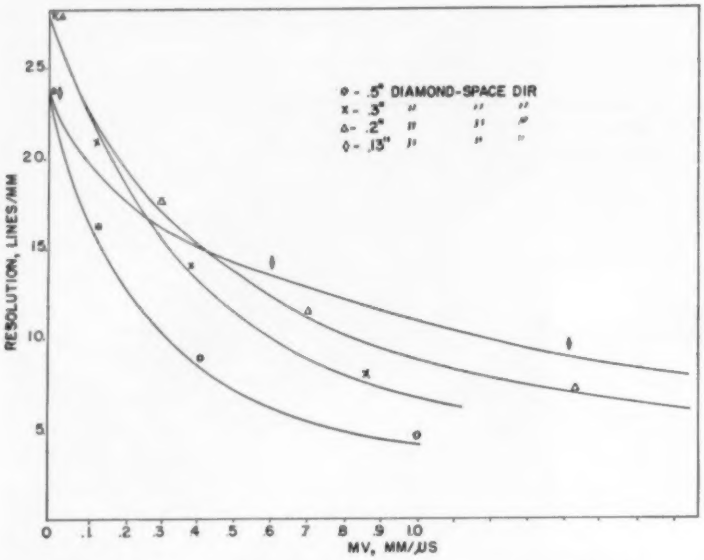


Fig. 5. Performance range of Model 192 camera at various stop widths.

study persists for longer than 55 µsec, methods to eliminate rewrite must be provided. In the Beckman & Whitley Model 192 Camera a blast shutter (Fig. 4) is provided to prevent rewrite.

The blast shutter is composed of two blasting caps and an optical glass block. A timed energy pulse initiates the blasting caps which, in turn, shatter the glass block. Light is thus effectively blocked from the camera system. The blast shutter requires about 12 µsec from full open to full closed. A shutter which would open rapidly would be extremely desirable and is currently being investigated.

An idea of the performance of this new camera can be gained from Fig. 5, which describes the resolution obtained at various shutter speeds. The loss of resolution at the higher speeds is an indication of the movement of the subject during exposure.

The first Model 192 Camera is nearing completion and is scheduled for installation at a major missile site. An approximation of the size of this instrument can be observed in Fig. 6. An idea of the complexity can be obtained from the fact that there are over 168 first surface mirrors, over 170 lenses, and over 400 optical components in the camera (Fig. 7).

Fig. 6. Model 192 Framing Camera ready for use.

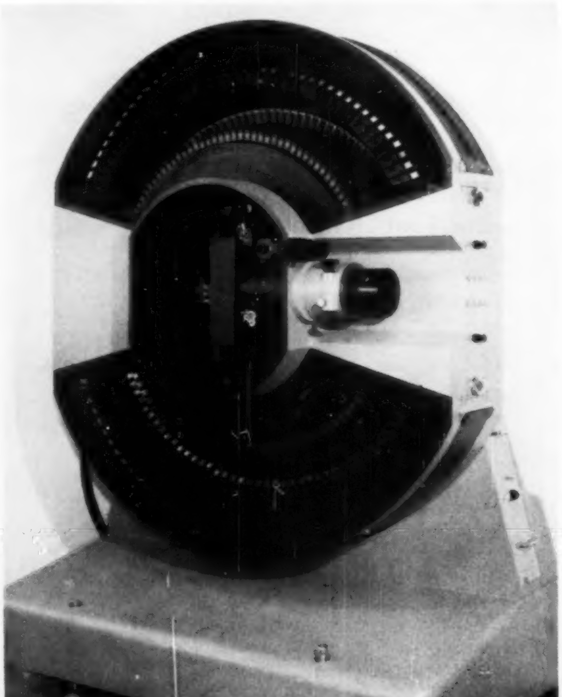


Fig. 7. The Model 192 Framing Camera showing the complexity of the number of first-surface mirrors, lenses and optical components.

Release-Type Pressure-Pad Mechanism for Mitchell Cameras

By FREDERICK T. O'GRADY

During the course of Samuel B. Grimson's investigations of the line-screen and the color reseau methods of color motion-picture photography, the production of perfectly sharp and even reproductions of the color screen elements in successive frames of the negative film presented a major problem. This paper describes a mechanism, adaptable to the Mitchell camera, by which the desired results are obtained. Although this mechanism was designed primarily for use in Grimson's color processes, it is also useful in other applications where maximum sharpness is important.

Introduction

Additive color processes in which separation is achieved by means of a color screen are not new. Thus in the well-known Dufaycolor* process, the film base constitutes a continuous color screen which also serves as the carrier for the photographic emulsion. From the cinematographic point of view, the disadvantage of this system is that it is subject to frame-to-frame color variations resulting from periodic and random imperfections in the color screen. A color process which avoids these difficulties by utilizing a single stationary and separate color screen was extensively investigated by Samuel B. Grimson. In this process each frame is exposed through a color screen permanently located in the focal plane of the camera. Alternatively, the color screen may be created optically in the camera aperture by means of a black-and-white line-screen and banded tricolor filter.† The negative color records obtained in this manner are utilized for the preparation of separation negatives or color prints in a printer in which the color image is reconstituted by optical projection.

In order that the maximum color reproduction be obtained, it is essential that the elements of the color screen be sharply reproduced in each frame. The camera used for making the original negative recording must therefore be capable of meeting a number of exacting requirements.

(1) The screen or reseau must be rigidly supported in a fixed position within the camera aperture, and held absolutely parallel to the plane of the film.

(2) During the periods of exposure, each successive frame of the film must be brought into exactly the same position relative to the camera aperture.

(3) The surface of the screen must not be damaged by contact with the film and, conversely, the screen must not damage the surface of the film.

Mechanism

Because of its wide acceptance in the motion-picture industry, the Mitchell Camera was selected as being the camera most likely to satisfy these requirements. However, it was found that the roller-type pressure plate commonly used in this camera did not produce the required results. The Mitchell roller-type pressure plate consists of a plurality of rollers held in constant contact with the film by means of a flat clamping spring which bears upon the rear of the roller supporting plate. This roller system has proven to be entirely satisfactory for ordinary film production purposes but negatives prepared with this arrangement showed frame-to-frame variations in the resolution of the screen pattern, undoubtedly caused by a varying and uneven contact between the film and the surface of the color screen. This condition was traced to irregularities in concentricity of the rollers, and also to accumulation of minute particles of film emulsion adhering to the surface of the picture aperture frame. The latter effect was found to be a direct result of the constant pressure of the rollers on the moving film.

Film tests made on a Bell & Howell Unit "I" Shuttle mechanism showed none of these defects. This finding prompted the design of a flat release type of pressure plate, that could be incorporated in the Mitchell camera in place of the constant-pressure, roller-type plate. In designing this mechanism, it was important to insure that no objectionable noise be generated by the mechanism, that the adaptation be made without any interference in performance of the existing Mitchell claw-and-pilot-pin mechanism, and that no structural changes be made in the Mitchell unit.

Figure 1 shows the completed, automatically operated, pressure-releasing system installed on the film claw-and-pilot-pin unit of a standard 35mm Mitchell Camera. Figure 2 is an exploded view of the working parts of the mechanism to show more clearly the order in which the parts are assembled. Except for the screen S, the parts shown in Fig. 2 are all supported by a baseplate 1 and comprise the complete mechanism which is interchangeable with the Mitchell roller-pressure-plate system.

As shown in Fig. 1, plate 3 of the Mitchell unit is secured to inner baseplate 16 by means of two screws 2 (Fig. 2). It will be noted in Fig. 2 that, integral with plate 1, there are two shouldered stud pins, 4 and 5, arranged to support two lever arms 6 and 7 and act as pivots for them. Lever 6 is mounted upon pivot pin 5 by means of a hole 8 bored half way between its ends. Located above hole 8 is an enlarged opening 9, within which stud 4 lies. This opening is of such size and shape as to permit oscillation of lever 6. With lever 6 mounted on the pin of stud 5 and straddling stud 4, lever arm 7 is then mounted upon pivot pin 4 by hole 11. Screw 12, which passes through holes 9 and 11 of levers 6 and 7, serves to hold the levers together in face-to-face contact to prevent end play. Connection between the two levers is made through pin 4 which is secured to the upper end of arm 7, and engages the forked end 15 of lever arm 6. Assembled in this way, the relative location of pivotal points 4 and 5 and connecting pin 14 effects a one-fourth reduction in the movement of the lower end of lever 6 relative to the movement of the lower end of lever 7.

L-shaped bearing 18 is secured to baseplate 1 by screws 19. Two holes (not shown) pass through the bearing and are arranged to receive slidably a pair of rods 21 which are firmly attached to plate 22. The extended ends of the rods are threaded and shouldered to fit into two holes of T-shaped bridge member 23. With the rods inserted in bearing 18, the bridge member is secured to the rods by two nuts 24. Leaf spring 25 is attached to the rear of plate 22 and, while maintaining a constant pressure upon the flat, perforated film pressure pad 17, holds the pad in a separated position from plate 22. The film

A contribution submitted on September 25, 1958, by Frederick T. O'Grady, 33-64 164th St., Flushing 58, N.Y. The machine was built by the author in accordance with suggestions by Samuel B. Grimson (Necrology, *Jour. SMPTE, 65:* 183, Mar. 1956).

* *The Dufaycolor Book*, Dufay-Chromex, Ltd., London, England, 1949.

† Seymour Rosin, "Samuel B. Grimson's investigations of the line-screen method of color separation and reproduction," *Jour. SMPTE, 66:* 209–212, Apr. 1957.

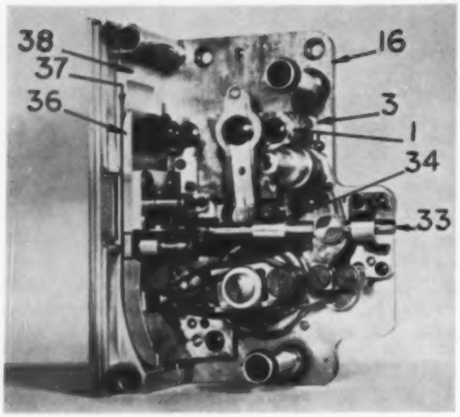


Fig. 1. Pressure pad and its releasing mechanism assembled on the claw-and-pilot-pin unit of a Mitchell Camera.

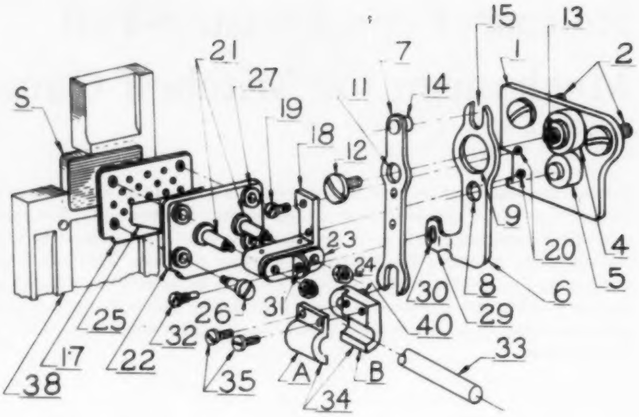


Fig. 2. Exploded view of the working parts of the release-type pressure-pad system.

pressure pad is slidably supported on plate 22 by four shoulder screws 26. The length of the shoulder screws is such that a slight compression of the pad is permitted while its outward movement is restricted by the screw heads. The diameter of the shoulders of screws 26 is sufficiently smaller than the diameter of their bearings in order to permit a leveling action of the pressure pad as it bears upon the film.

With plates 17 and 22 held by bracket 18 to the face of plate 1, a threaded hole 31 of T-shaped bridge member 23 is aligned with a vertical slot 30, milled into the lateral extension 29 of lever arm 6. Pin-end screw 32, tightly screwed into hole 31 with the pin portion of the screw engaging elongated slot 30, links together the lever and pressure pad assemblies. Referring to Figs. 1 and 2, it will be noted that pressure pad 17 and its supporting plate 22 occupy the aperture in film guide plate 36 which was previously occupied by the Mitchell roller-type pressure plate.

The driving power of the film pressure pad system is derived directly from Mitchell pilot-pin shaft 33 by means of coupling 34. In order to facilitate its installation, this coupling is made in two sections A and B (Fig. 2). Pin 40, extending from the rear and forming part of section B, is arranged to engage the forked lower end of lever arm 7. The coupling is installed by first hooking section B over Mitchell pilot-pin shaft 33, and then tilting it backward to a vertical position in order to place pin 40 within the forked end of lever arm 7. Section A is then placed upon the shaft and held loosely to section B by means of screws 35. Before finally clamping the coupling rigidly to the shaft, the Mitchell mechanism is rotated until the pilot pins have settled in their position of maximum withdrawal. The coupling is then slid along shaft 33, until it is observed that the surface of pressure pad 17 is on the same plane as the surfaces of the film runners of guide plate 36 of Fig. 1. Finally, sections A and B of coupling 34 are securely clamped to the shaft thus completing the assembly ready for camera operation.

From this description, it will be obvious that the reciprocation, the direction of travel, and the timing of the action of the pressure pad, will be identical with those of the Mitchell pilot-pin shaft. However, while the pilot-pin shaft is making its normal full stroke of approximately 0.100 in., the stroke of the pad supporting plate 22, by reason of the reducing leverage, will be approximately 0.025 in. As shown in Fig. 1, channel 37 is formed between plates 36 and 38 of the Mitchell unit into which the film is threaded. The depth of this channel is approximately 0.020 in. and, in order to thread the film into this channel for camera operation, the pilot pins are moved backward in the usual manner. Simultaneously with the withdrawal of the pins, the outer surface of the pressure pad is positioned level with the surface of the runners of film guide plate 36. With the film threaded within the channel, the remaining gap will be approximately 0.015 in. Therefore, when the pressure pad is moved forward to contact the film, its action will be restricted to 0.015 in. This restriction in the movement of the pressure pad and the continuing forward movement of supporting plate 22 result in leaf spring 25 becoming further tensed. Consequently, the leveling action of the pressure pad goes into effect, and the film is pressed into close and even contact with the surfaces of aperture plate 38 and the screen S. After exposure of the film frame has been made, the pressure pad and the pilot pins are completely withdrawn from the film. Thus the film is permitted to pass freely through the camera without any damaging contact with the aperture plate or the screen surfaces.

Conclusion

This mechanism was used experimentally for many years in the laboratory of Color Research Corporation and consistently produced sharp and even reproductions of the line-screen and color reseau elements in frame-to-frame exposures. In addition to satisfying requirements for proper color reproduction by the Color Research process, the mechanism is smooth, quiet and mechanically stable.

A Method of Measuring the Steadiness of Motion-Picture Cameras

By A. C. ROBERTSON

The unsteadiness of cameras can be evaluated by a double-exposure technique using a "step-wedge" shaped object for the first target and a simple bar for the second. The results are obtained in the form of individual, whole values. Hence, simple counting methods are used in analyzing the data rather than complicated measuring equipment. Consequently there is less fatigue for the observer. The action of some cameras is described, and their errors are analyzed by the use of this technique.

Much work has been done to produce steady motion pictures, for an unsteady motion-picture image does a great deal to destroy the illusion of reality that its producers desire. The steadiness of the image on the screen depends upon a number of things such as the mechanical characteristics of the projector, the printer and the film. However, one of the most important items is the steadiness of the camera making the exposure. Nothing done later will completely cure difficulties initially caused by an unsteady camera. This is true whether we are considering the action of a simple amateur 8mm, or a 16mm camera making a single set of exposures, or the operation of a precise professional process camera which superimposes two sets of exposures to produce "effects."

History

There are a number of ways of testing camera unsteadiness. Some of these use single-exposure techniques. For instance, it is assumed that the film is inherently uniform in dimensions. It is further assumed that a selected or specially adjusted projector will introduce a negligible error into the test. The work then goes ahead on these assumptions with special care being taken with the examination of the projected image. Useful work can be done this way by skilled personnel, with the cameras being ranked in order of their performance. However, the assumptions prevent the ratings from having a great deal of permanent (or absolute) value.

Another single-exposure technique is to observe the steadiness of the projected image from a projector equipped with a "cut-out" gate. By the use of a projector thus altered, one can see the image of the perforations as well as the image of the test object or the camera frameline. Useful observations can be made this way, especially when the perforation images appear to stand still. Otherwise the interpretation can be difficult and tiring.

If reliable data free from personal bias or fatigue are to be obtained by viewing the usual projected images, one must either use a jury for evaluation or employ some sort of mechanization. This mechanization can be accomplished with photoelectric cells, using a graphical record vs. time[1] or a cumulative frequency-distribution[2] to assist in the interpretation of the results.

A third method of using single-exposure tests employs "pie charts" having very small sectors. This technique enables one to rank cameras with respect to steadiness. Presumably, this is possible because persistence of vision gives visual impressions much like those obtained from double-exposure tests. However, we have discovered no reliable way to make such results quantitative, or to give them permanent, numerical form.

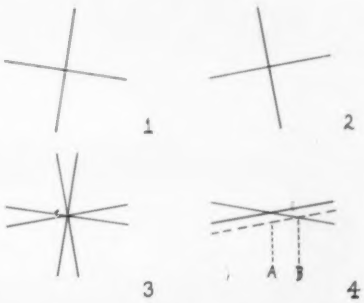
After considering all the available methods of measuring camera unsteadiness, it seems to us that the double-exposure technique remains the best method of evaluating the ability of the camera to place the film in the proper spot in the gate time after time.

Many targets have been used in the past for double-exposure camera steadiness tests. The targets range in style from calendars or pages of news print to special charts. In either case, one of the targets is moved between exposures. One of the simplest charts that can be used was suggested by E. K. Carver long ago, during studies done for the Society's Film Dimensions Committee. It consists of a target with a vertical and a horizontal line. The first exposure is made with the target tilted to the right (Fig. 1), the next with the target tilted to the left (Fig. 2). The resulting picture shows two sets of intersecting lines (Fig. 3). If there is camera unsteadiness, the location of the intersection moves. In Fig. 4, only the "horizontal" lines have been drawn for the sake of clearness. Vertical unsteadiness would mean the intersection on the horizontal lines would move, as indicated by the dotted line, from point A to point B. This method has been extended by M. G. Townsley[3] who used a group of parallel black and white lines of equal width. The use of slanted lines requires judgment in recording the results because one must describe how the point of intersection moves. To do this requires interpolations to be made on a graduated scale of values.

Since it seemed worthwhile to avoid such operations involving estimation of small fractional values, it was decided to employ a method which uses discrete, whole values. Accordingly, the step-wedge method was developed. Here the observer notes at which location a gap is barely observable on a target. Fine distinctions are not possible in this method, but experience has shown that the results are adequate. The fact that fatigue is diminished makes the possibility of observer error smaller. There is also the added advantage that the required equipment is simple: there are no separate measuring scales needed, because the targets themselves permit only a "yes" or "no" indication. A disadvantage is the slowness of the procedure, which is offset by the fact one has a diminished maintenance schedule on the equipment. The following describes a simple apparatus we have found to be generally useful. In fact the method promises to be one that will give comparable results from a number of users.

Method

At times we have used targets ruled on cards. These were difficult to make and troublesome to handle. It is particularly



Figs. 1–4. Schematic drawing of tilting targets.

Presented on April 24, 1958, at the Society's Convention in Los Angeles by A. C. Robertson, Eastman Kodak Co., Manufacturing Experiments Div., B-35, Kodak Park Works, Rochester 4, N.Y.

(This paper was received on March 17, 1958.)

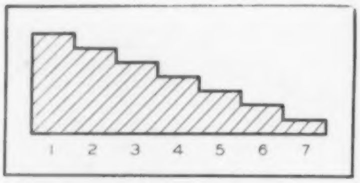


Fig. 5. Schematic drawing of "step-wedge" or stair-step target.

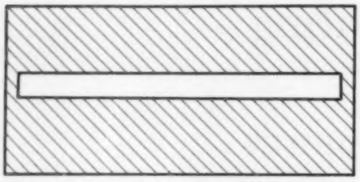


Fig. 6. The straight-edge or "white" bar target.

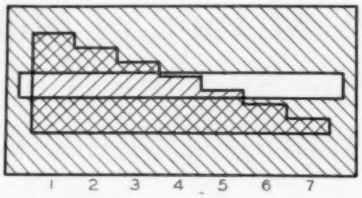


Fig. 7. Superposed stair-step and white bar.

difficult to place cards in position with an error of only a few thousandths of an inch. Since the cards cannot be made accurately on a small scale, they must be used at a considerable distance, which is an additional disadvantage. The illumination of the cards is also something of a problem, so the current equipment was designed to use transmitted light from an illuminator designed for the examination of x-ray film which is a self-contained light source commonly employed by physicians. The first target appeared like Fig. 5, which resembles stair-steps viewed from the side. These steps represent the discrete value previously discussed, and thus differ from a slanted line which could have any number of points designated on it. The second target consists of a straight edge, which may be regarded as the top of a "white" bar, if one finds that concept useful. It gives an image like that in Fig. 6. When the two targets are superimposed the effect is like that in Fig. 7. In this case the two targets do not touch at step 3, but almost touch at step 4. It does not matter how big the gap is when the steps are said to "touch," as long as the observer is constant in his judgments. This combination of targets, when displaced 90°, obviously can be used to measure lateral unsteadiness. The intersection of the two figures on the final, double-exposed picture would always come at a certain step or station if the camera were perfect. The failure to do so will be discussed later.

Now let us discuss details of the actual test.

(At this point in the Convention presentation a motion picture was projected to show the details of construction of the equipment and how the tests work. Figures 8–12 are from the motion picture.)

The targets described schematically in Figs. 5, 6 and 7 were not used in the exaggerated form shown in the sketches. They were actually cut from $\frac{1}{16}$-in. sheet-brass and located on a frame by the use of accurate steel dowel pins. This construction gives precise positioning easily, which had not been possible with the relatively soft, ill-defined edges of cardboard upon which the targets were formerly drawn.

While ordinary hand workmanship will suffice for most parts of the equipment, the manufacture of the step-wedge used in Target I (depicted by Fig. 5) calls for precise milling. Each step is 0.025 in. high and about 1 in. wide and has the edge made narrow by bevelling with a file. When used at a distance of about 60 in., this bar gives an image on the film having steps of 0.0004 in. for the 25mm lenses generally used on a 16mm camera. There are 11 steps (top portion of Fig. 8) thus giving a range of about 0.0045 in. The second strip used for Target II (depicted by Fig. 6) has a rectangular hole in it. The effective edge of the bar is coincident with the middle step of the step-wedge thus giving five steps above and five steps below the point of expected coincidence of the images. Note that it is not important whether Target I or Target II is used first at a given station: the important thing is to interchange them between exposures (Figs. 9 and 10)

A large L-shaped frame is fastened to the front face of an x-ray illuminator by means of bolts put through existing holes (Fig. 11). This frame holds two sets of dowel pins. One end of each target piece has a round hole which fits snugly on a round pin. The other hole is rectangular and is held against the flat surface of a D-shaped pin by a spring detent. The D-pin is used since it is difficult to secure good operation with two round holes on account of the cramping that can arise from uneven heating of the various parts. We find that better results are obtained if the fluorescent lights (if any) are replaced by incandescent. Otherwise the 60-c flicker can give uneven exposures.

The first exposure is made, and the film rewound and replaced in the camera. Then the two target strips are interchanged. The second exposure is then made, adding a tell-tale or "slate" written on thin paper or acetate sheeting to identify the experiment. We have found that the camera may rotate during the reloading operations. If a tiny mirror is fastened to the camera by wax and a parallel beam of light is directed at it, an optical pointer is realized. With the aid of this pointer, alignment azimuth may be checked accurately before the second exposure. If the mirror is placed on the front of the camera, then the position of the camera can be verified both in elevation and azimuth. The assembly is shown in Fig. 12.

After the film is processed, it can be projected in the normal way for qualitative inspection. Such an examination may not disclose all the jumps or allow one to estimate their size.

Please note that a considerable degree of skill is needed to evaluate camera steadiness of a projected test by simple observation when either the projector or the film is not "perfect." Often, motion from these two causes confuses the observer who is supposed to note only the relative motion of the two pertinent lines or other marks, and not the jump of the picture as a whole.

The full advantage of the method is obtained by examining each frame and noting the point of "intersection" or matching of the exposures. Under these circumstances, neither film nor projector inaccuracy interferes. A Kodaslide projector or a low-power microscope can be used, though a microfilm viewer is easier to use. A chart can be made plotting the

Fig. 8. Sheet-brass step-wedge and white-bar targets.

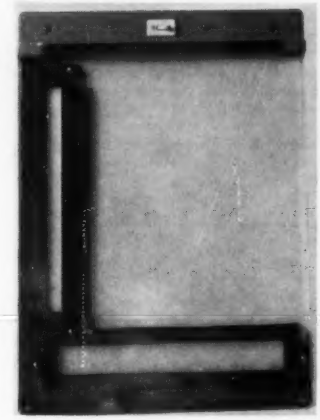


Fig. 9. One position of the targets on the frame.

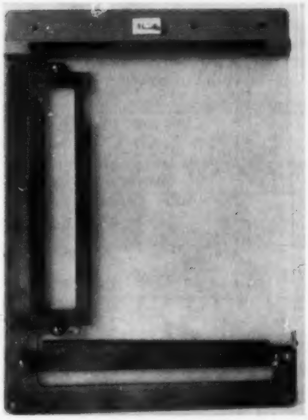


Fig. 10. Interchanged position of the targets on the frame.

location of the intersection against the serial number of the frame.

Results

Figure 13 shows the vertical unsteadiness of two 16mm cameras. The chart above shows the data for a camera in poor repair, and the one below for a camera in good shape. Figure 14 shows the horizontal steadiness in similar fashion. Note the relative magnitude of the vertical and horizontal unsteadiness. Even in this "poor" camera the horizontal steadiness, as shown in the film, is excellent and so is the horizontal steadiness of the projected image.

This unexpected result probably can be explained by the use of guiding on the same side in both camera and projector, and by the fact that the guides on the edge do not move. Such "consistent" guiding is of the greatest value and should always be utilized. The vertical guides, i.e. the claws, do move and hence can have "play." Figure 15 shows the unsteadiness of a 16mm camera which was notably bad in the sideways direction. We are not certain of the cause. Probably the spring-loaded edge-guiding member did not make contact with the film and thus function as it should.

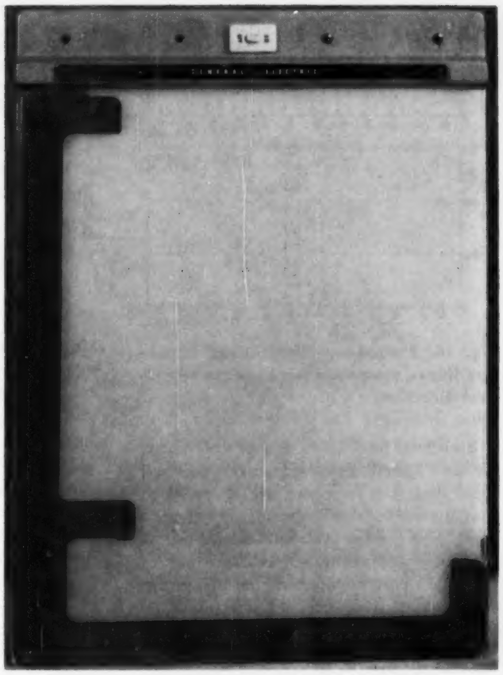


Fig. 11. L-shaped frame fastened to the front face of an x-ray illuminator.

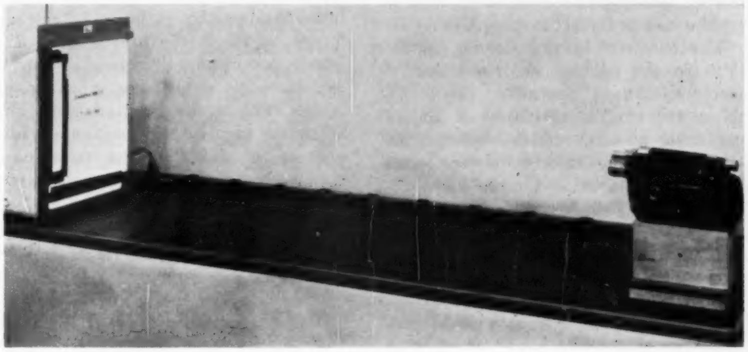


Fig. 12. Illuminator and camera in position for testing.

Unless a drift is present, this method of showing the data does not offer a great deal more information than the construction of a frequency-distribution diagram. In making such a condensation of the data, tallies can be kept on paper, but the use of a bank of counters such as those made by Veeder is more convenient. See Figs. 16 and 17 which show frequency-distribution diagrams for the vertical and horizontal directions for the data shown in Figs. 13 and 14. If all the observations occurred at one station, the results would be perfect. The more stations at which a match was found, the worse the results.

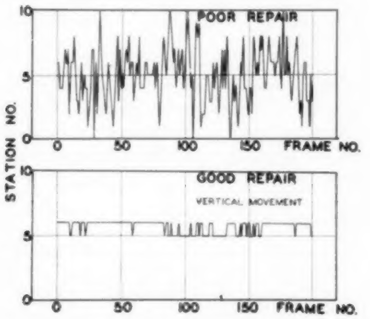


Fig. 13. Frame-by-frame charts of unsteadiness of cameras in poor repair and good repair — vertical direction.

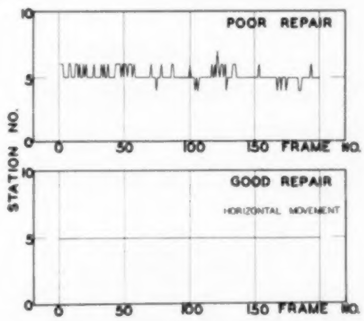


Fig. 14. Frame-by-frame charts of unsteadiness of cameras in poor repair and good repair — horizontal direction.

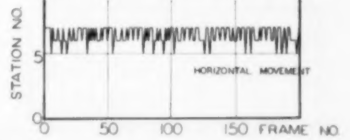


Fig. 15. Horizontal movement in suspect camera.

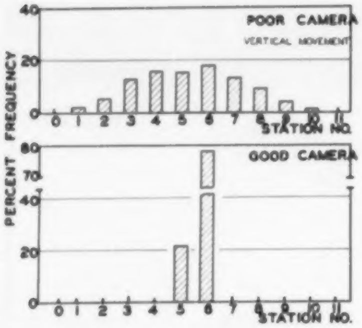


Fig. 16. Frequency distribution of unsteadiness, poor vs. good cameras — vertical direction.

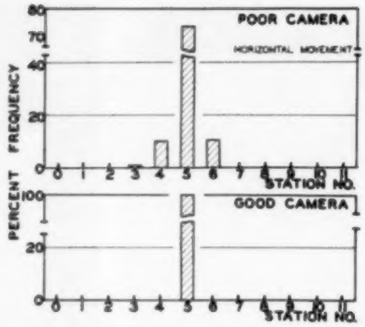


Fig. 17. Frequency distribution of unsteadiness, poor vs. good cameras — horizontal direction.

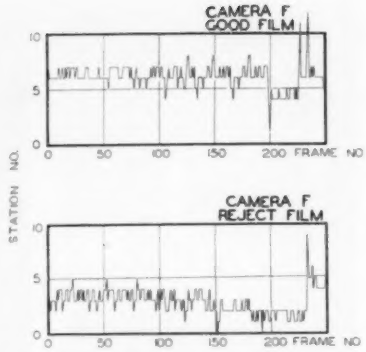


Fig. 18. Frame-by-frame unsteadiness, good film vs. reject film, Camera F.

Standard deviations can be calculated for the dispersion of the results if wanted. Note that two processes are involved so that the value obtained must be divided by $\sqrt{2}$ to get the standard deviation for the single operation. Since "stacking" of variables can occur now and then, it seems that 100 or so measurements should be taken a number of feet apart to get values which can be used to typify the action of the camera. Any great difference between observations in such a set may call for further investigation.

The effects of varying driving conditions in the camera are sometimes a factor in camera operation. Figure 18 shows the vertical steadiness of an inexpensive amateur camera tested with two lots of film. Observe that the series of readings charted at the top shows results not much different from the chart shown below. The bottom chart shows the performance of film which had been rejected because it did not quite conform to specifications.

There was little difference in the performance of the two films. However, a very interesting aspect of both graphs is the drift. Shortly before the camera stops near frame 230, the image changes location considerably. This happens with both films. This effect was not observed on another inexpensive camera, as shown by the data in Fig. 19. Neither has it been found on several cameras which one might call semiprofessional, even though one of these did not quite conform to all expectations, showing marked lateral unsteadiness which was noted in Fig. 15. Note in this connection that most semiprofessional cameras stop automatically before the spring power decreases to a low value.

The results noted above suggest that variation in camera performance sometimes can be greater than the effects brought about by variation in the uniformity of longitudinal pitch of the film. Ideally, errors of perforating in a double-exposure test should not influence the results. This would be particularly true when the camera had positioning pins, one of which filled the perforations closely. Actually most 16mm cameras use claws for positioning, and the distance the film must be advanced apparently plays a part in determining the location it finally assumes in the camera gate. These comments may explain why definitely "bad" film (as distinguished from slightly bad or "reject" film) shows an effect from pitch variation.

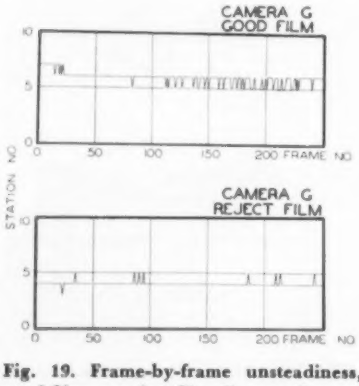


Fig. 19. Frame-by-frame unsteadiness, good film vs. reject film, Camera G.

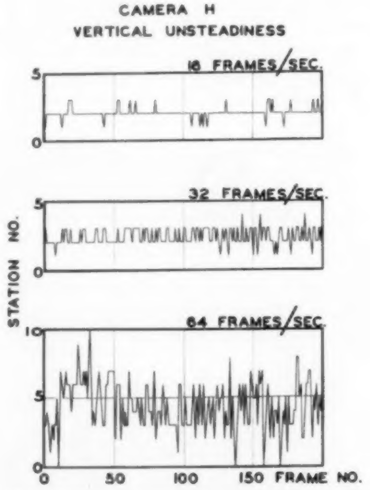


Fig. 20. Frame-by-frame unsteadiness vs. camera speed, Camera H.

Note that the ASA range for variation in dimension B is ± 0.0005 in. or 0.0010 in. in all. This corresponds to $\pm 1\frac{1}{4}$ steps or $2\frac{1}{2}$ steps in all. An envelope this wide covers all the trace for what we have called "good" films or "good" cameras. The envelope for other cameras is wider.

Another example of the use of the target is to be found in Fig. 20 which shows the vertical steadiness of a camera at several speeds. The film used at the three speeds was the same. We have observed that not many cameras are steady at 64 frames/sec. This is not the gravest of defects, since exciting action is almost always present at higher speeds and distracts one's attention.

Conclusion

These examples show various applications of the method we used in measuring unsteadiness. It depends upon the interests of the user as to what method he uses for permanent records of the results. A camera repairman would use a simple technique which might be the recording of the fraction of frames exceeding a band of one or two steps. This band, of course, can be made smaller for studying process cameras, by increasing the distance from camera to target. Someone studying a totally new process, let us say, would require a more efficient use of the data. He would probably calculate standard deviations, search every step in the process, and even look for cyclic effects.

In closing, I wish to acknowledge the help of my colleagues at Eastman Kodak Company, and in particular the work of W. H. Groth, who performed most of the tests.

References

1. W. G. Hill, "Modified negative perforations," *Jour. SMPTE, 57:* 108–123, Aug. 1951; R. W. Lavender, "Evaluating film steadiness," *ibid.:* 124–130, Aug. 1951.
2. A. C. Robertson, unpublished work.
3. M. G. Townsley, "A method for measuring the steadiness of motion picture cameras," *Jour. SMPE, 43:* 45–51, July 1944.

Discussion

Ralph Haburton (*U. S. Air Force*): In the test you showed, what was the distance from the target to the camera?

Dr. Robertson: Approximately 60 in.; this is the reason we use metal targets so that the camera can be put on a bench. We thus eliminate vibration problems since the bench, the target and the camera all vibrate together. If finer steps are required, you could move the camera back to 12 ft or even to 20 ft. Alternatively, you could make another set of targets with stairsteps of ten thousandths of an inch in height instead of twenty-five thousandths.

Mr. Haburton: In terms of focal length, what was the distance?

Dr. Robertson: We had a 1-in. lens, which is the typical lens used on 16mm cameras.

Mervin LaRue, Jr. (*Bell & Howell Co.*): Have you attempted to differentiate between objectionable unsteadiness and the lower frequency (and possibly less objectionable) unsteadiness which might be called "wandering?"

Dr. Robertson: No. But, of course, we all know that the higher frequency vibrations are the most objectionable.

Television Zoom Lenses

By GORDON H. COOK

The advantages to be gained in outside broadcast presentation by the use of camera lenses of variable focal length have been well established with the aid of lenses designed for that purpose. If similar advantages are to be provided under the different operating conditions encountered in the studio or in industrial television, new types of lenses with more extreme optical characteristics are necessary. The solution of these new optical problems yields a zoom lens ideally suited for a wide variety of television applications.

In recent years the advantages that arise from the use of varifocal or zoom lenses have become well established and, because of their varied applications, they are now an essential item in camera equipment. These advantages often prove to be particularly valuable in television where continuity of presentation to the viewer can set operational demands which differ from those experienced in cinematography.

Presented on October 22, 1958, at the Society's Convention in Detroit by Benjamin Berg for the author, Gordon H. Cook, Lens Design Dept., Taylor, Taylor & Hobson Ltd., Stoughton St., Leicester, Eng.

(This paper was received on October 14, 1958.)

Many workers in the field of television optics have shown that lens performance makes a significant contribution to the overall subjective quality of television presentation, and arguments that inferior camera lenses are good enough for television are now discredited. The full advantages of varifocal lenses can, therefore, be obtained only if they yield an optical standard of performance which is comparable with that of the range of normal lenses they are intended to replace. At the present time, varifocal lenses can no longer justify their existence merely by the novelty of their zoom characteristics and no real and lasting advantages are to be obtained if unusual zoom specifications are provided only at a sacrifice of optical performance.

One of the main features of all useful varifocal systems is that the plane of best image definition remains in a fixed position relative to stationary parts of the system as the focal length is continuously varied throughout the range provided. This feature can be provided in only two distinctly different arrangements of optical component movements.

In one type of varifocal lens there are at least two lens components whose movements differ from one another. One movement can be considered as producing change of focal length and the other as image-shift compensation holding a stationary image plane. At least one of these movements demands the use of some kind of nonlinear linkage or cam control. This type of varifocal system can be classified broadly as relying on mechanical compensation for image shift.

A typical example of this first type of component movement is shown in Fig. 1. Movement of the middle component

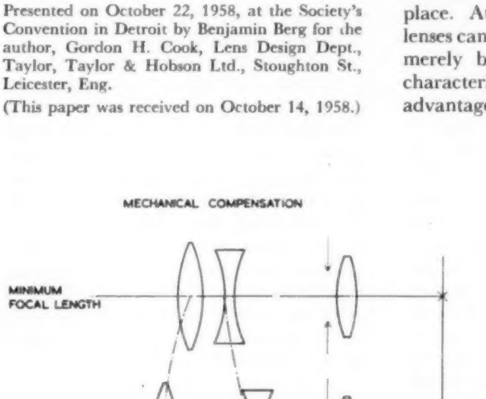


Fig. 1. Three-component varifocal system, two of whose lens components have movements which differ from one another.

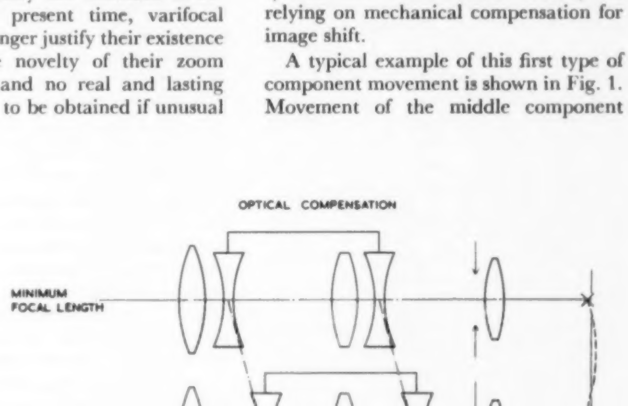


Fig. 2. Varifocal system, at least two of whose lens components are movable with the movements identical so they may be linked together mechanically as a single linear movement.

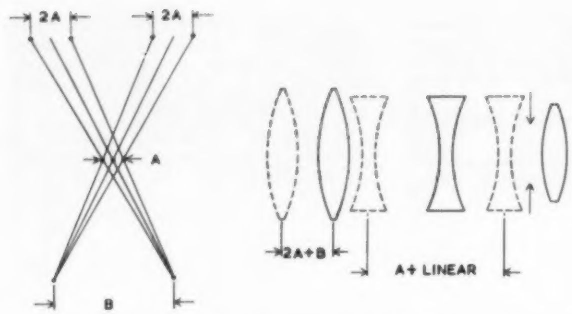


Fig. 3. Diagram showing arrangement in which departure from linearity of one movement is made exactly half the actual movement of the other.

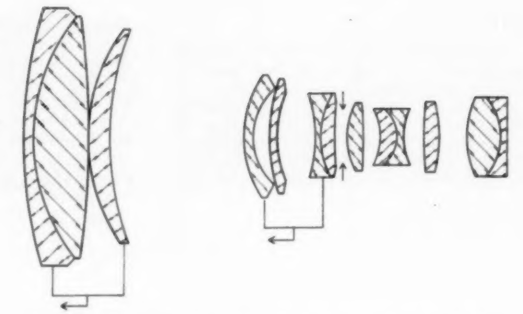


Fig. 4. Optical construction of the Studio Varotal, the new varifocal lens in its vidicon form. This version has a maximum relative aperture of f/1.8 throughout continuous variation of focal length in the range of $2\frac{1}{4}$ to 8 centimeters.

changes focal length while a smaller movement of the front component maintains the image plane in a fixed position relative to the stationary rear component.

The second type of varifocal lens comprises a sequence of alternate stationary and movable lens components. At least two components are movable and the relative powers and positions of all components are chosen to permit the two movements to be identical so that they may be linked together mechanically as a single linear movement.

A typical example of this second type of component movement is shown in Fig. 2. All systems of this second type provide exact compensation for image shift at only a number of points in the range of focal lengths, leaving small and sometimes negligible errors of focusing at points intermediate between the corrected points. They may be classified broadly as relying on optical compensation for image shift.

In both types, the iris stop of the system is ideally situated near the stationary rear component, while focusing for varying object distance is achieved by further movement of the front component. The ratio between maximum and minimum focal length is set by the construction of the moving components while the power of the stationary rear member can be selected to yield the desired numerical focal lengths.

Both types have been used successfully in American and European television during the last few years and the failure of one to supersede the other confirms the opinion that mechanical compensation offers attractive optical advantages provided they are not offset by the presence of errors of movement arising from inefficient mechanical construction. Extensive use of mechanically compensated varifocal lenses in outside broadcasting has established the fact that, in their range of focal lengths, they can yield at full aperture an optical performance which is at least as good as that of any normal lens.

All the problems of varifocal lens design become more serious when an attempt is made to meet the requirements of studio and industrial television. Restricted operating space demands the use of wider angular fields of view and the ability to focus on objects much nearer to the camera. If relative aperture and the vignetting of oblique illumination are to be held at an acceptable level, these two requirements tend to be incompatible optically and they prompt a closer investigation into the relative merits of the two broad types of varifocal systems that are possible.

In all varifocal systems, the front component must move in a forward direction to focus on near objects and the extent of this movement for a given range of object distances is inversely proportional to its power. Under studio conditions of wider angular field and nearer object distance, there are a number of optical and mechanical reasons to restrict this forward movement as much as possible by the use of a powerful front component.

The front component's contribution to oblique aberration is dependent on both its power and its distance from the iris stop near the stationary rear component. If the front component is powerful for reasons of short-distance focusing, it follows that its distance from the stop should be kept to a minimum by restricting the space occupied by the intermediate moving components which yield variation of focal length.

Varifocal systems of the optically compensating type have a minimum of two identical movements, shown in Fig. 2; and the overall length of the system cannot be less than the sum of those movements.

The mechanical compensating system of Fig. 1, however, achieves its variation of focal length by the movement of one middle component plus a much smaller movement of the front component for image-shift compensation. Its overall length, therefore, can be appreciably less than that of an equivalent optically compensating system with component movements of similar extent.

It then becomes necessary to consider the correction of optical aberrations in the two basic types. The problem is one of achieving stability of all aberrations throughout the variation of focal length, leaving final correction of these to be achieved by the equal and opposite aberrations introduced by the stationary rear component.

In many ways, the achievement of aberrational stability in the varifocal section of the system is much more difficult than the final correction in the stationary rear component. In both basic types of system, primary aberration can be stabilized without undue difficulty but, if high standards of optical performance are to be achieved, an adequate degree of stabilization of higher-order aberrations is also required.

Instability of aberration arises from the fact that the components in front of the stationary rear component work under varying conditions of relative aperture, conjugate distance and stop position during variation of focal length. Their primary and higher-order aberrations consequently vary considerably, and it is not a simple matter to balance them in such a way that for each aberration the sum of the contributions from all components is stabilized at a constant level throughout the focal range.

If advantage is taken of the reduced axial length and fewer components of the mechanically compensating type of system, it becomes possible to utilize more complex optical constructions for the moving components. The extra complexity can be incorporated without significant increase in overall dimension and the extra design variables assist the designer in achieving a higher degree of stability for primary and higher-order aberrations. The same freedom permits the axial length of the stationary rear member to be increased to facilitate a more exact balance of all aberrations in

Fig. 5. Studio Varotal for vidicon cameras — maximum relative aperture, f/1.8; focal-length range, $2\frac{1}{4}$ to 8 centimeters.

Fig. 6. Studio Varotal for image-orthicon cameras — maximum relative aperture, f/4.5; focal-length range, $2\frac{1}{4}$ to 8 inches.

the final correction. A more complex front component not only assists the stabilization of aberration with change of focal length, but also provides more stable conditions throughout wide variation of object distance.

The standard of optical performance achieved with a varifocal system designed on these lines fully justifies the adoption of mechanical compensation for image shift and demands a new approach to the problems of mechanical design and manufacture.

In general, the mechanical problems arise from the fact that mechanical compensation demands three distinctly different component movements. One is required for variation of focal length, one for image-shift compensation and one for object-distance focusing. If the system is also to fulfill the ideal condition that variation of focal length is logarithmic with respect to linear movement of the zoom control, it often becomes necessary to incorporate different nonlinear movements for both the components concerned with focal variation and image-shift compensation.

An arrangement has been devised, however, in which the departure from linearity of one movement can be made exactly half the actual movement of the other. This permits the ideal rate of zoom to be achieved with only one nonlinear movement while maintaining exact image-shift compensation. Furthermore, by allowing the movement of the front component to serve the dual purpose of image-shift compensation and also focusing for different object distances, the number and size of moving parts can be reduced and the external focusing control can be positioned more conveniently at the rear of the lens body.

The fundamental principle adopted in this arrangement is shown diagrammatically in Fig. 3. The two-to-one relationship between the two component movements can be considered as equivalent to a lever arrangement. When zoom movements only are applied, the bottom of the lever acts as a fulcrum and the movement at the top of the lever is twice that in the center. The top movement is equal to the required movement of the front lens component for image-shift compensation, while the middle movement is equal to the departure from linearity of movement for the middle lens component.

When focusing movement of the front component is required, the center point of the lever acts as a fulcrum so that movement of the bottom of the lever imparts a corresponding movement to the top and thus to the front lens component. The lever, therefore, has two distinct fulcrums, one for variation of focal length and one for object-distance focusing, and each acts as required, irrespective of the position of the other.

The adoption of this principle simplifies the mechanical construction of this type of varifocal system and yields dimensional advantages such that all optical and mechanical components can be contained within a cylindrical barrel which can be mounted directly onto cameras without any necessity for special mounting brackets.

The problems of reducing wear and backlash in the moving parts to an insignificant level have been solved by the application of modern manufacturing techniques to selected materials and by an extensive use of rolling actions in place of those sliding actions which have previously proved objectionable in this type of construction.

The measured performance figures which follow have been held consistently throughout the production of a number of varifocal lenses made to this design and they can be repeated without change after accelerated wear tests equivalent to 20,000 zoom cycles. While it cannot be claimed that backlash is completely absent, the residual errors are too small to affect the performance figures quoted and their effects are significantly smaller than the residual errors of focus which would be present in an equivalent lens based on the principles of optical compensation for image shift.

Figure 4 shows the optical construction of this new varifocal lens which has been named Studio Varotal. It has a dual purpose, since a simple interchange of the rear member behind the iris diaphragm adapts it for use on either vidicon or image-orthicon television cameras.

Figure 5 is a photograph of the Studio Varotal in its vidicon form. It has a maximum relative aperture of $f/1.8$ throughout continuous variation of focal length in the range $2\frac{1}{4}$ to 8 centimeters. In its image-orthicon form, as shown in Fig. 6, the relative aperture becomes $f/4.5$ and the focal range is $2\frac{1}{4}$ to 8 in. The ratio between inches and centimeters is the same as the ratio between the two picture format dimensions so that both forms cover the same range of angular fields of view. Both will focus down to an object distance of 5 ft, while holding true zoom characteristics — a distance unusually small in varifocal lenses having these wide angular fields and wide relative apertures. At maximum focal length and minimum object distance, an object having dimensions of $8\frac{1}{2}$ by $6\frac{1}{2}$ in. will fill the picture format.

Performance has been measured photoelectrically in white light and is expressed in terms of percentage modulation to a square-wave grating test pattern at a frequency corresponding to the number of picture elements contained in one television picture line. In the case of image-orthicon cameras, a pattern frequency of 8 patterns per millimeter corresponds to about 500 picture elements per television line which slightly exceeds the information-carrying capac-

ity of standard American and British television channels.

The image-orthicon version of the Studio Varotal yields a standard of performance in the central areas of the picture format which is unusually high even for normal-type fixed lenses. At maximum aperture, modulation at the limiting frequency of 8 patterns per millimeter is maintained above 95% at any point in the full range of focal lengths. This high value implies remarkable freedom from optical aberrations, precise image-shift compensation and freedom from backlash in the moving parts.

Full aperture off-axis performance is also well up to the standard demanded and does not deteriorate rapidly towards the corners of the picture format. At image positions corresponding to two-thirds of the angular field, modulation at the limiting frequency is held above 75% at all points in the focal range.

The performance yielded by the vidicon version of the Studio Varotal is not significantly worse than the values quoted for the image orthicon in spite of its wide relative aperture of $f/1.8$ and the fact that the limiting pattern frequency for the vidicon tube is increased to about 20 patterns per millimeter.

Further outstanding advantages arise when the image-orthicon Studio Varotal is used on color television cameras of the optical-relay type. When standard camera lenses are used for this purpose, field lenses have to be inserted in front of their focal plane to redirect the light from the lens so that it will enter the optical relay system of the camera. These field lenses are not corrected for aberration and they are more powerful than the camera lens itself. Although their position close to the focal plane minimizes their effect on some optical aberrations, their contribution to field curvature is independent of position and proportional to their power. The combination of camera lens and field lens, therefore, has a degree of field curvature which is at least as large as that of an uncorrected lens.

The image-orthicon Studio Varotal has its own built-in field lens characteristics so that light reaching its image plane always proceeds in the direction demanded by the optical relay system of the color television camera. This has no detrimental effect on performance with black-and-white camera systems, but the ability to dispense with field lenses in the color camera has very significant optical advantages which have been well confirmed by observed results.

Some of the optical advantages to be gained from the adoption of mechanical compensation for image shift have been described in this paper. The most important characteristics which differ from those of optically compensating systems arise from the fact that the fundamental arrangement of individual components is more simple and occupies less space. This permits the use of complex optical constructions for each member while the overall complexity and size of the complete system is maintained at a practical level. The more complex components allow all aberrations to be held within unusually small tolerances under varying conditions of use. Efficient design and manufacture overcome mechanical difficulties which, it is alleged, have hitherto limited the performance and usefulness of this type of varifocal system.

Acknowledgment

Thanks are due to Tayor, Taylor & Hobson Ltd. for permission to publish this paper.

Gaumont Chronochrome Process Described by the Inventor

By LEON GAUMONT

Editorial Note: *A paper found among the effects of Leon Gaumont after his death in 1946 describes his early attempts to sychronize sound and image and discusses apparatus which he invented, such as the Chronophonograph and the Elgephone. As a tribute to this inventor, whose name is on the Honor Roll of the Society, and for the interest it may hold for contemporary scientists and inventors, the Historical and Museum Committee has contributed the following translation. Special assistance was given by L. J. J. Didiee of Paris in connection with the obtaining and preparing of this paper.*

My first method of synchronizing sound and image was presented at a meeting of the Photographic Society in Paris on November 9, 1902. Although the idea of synchronization was not new, the first patents on this subject had just appeared at that time. Serious attempts had been made previously, especially by the French inventor, Baron, the principles of whose method have been partly incorporated in my method.

The phonograph was the most delicate of the two kinds of apparatus used in this sound motion-picture projection presentation. It had to assume the functions of an orchestra leader, that is to say, an instrument controlling the motion-picture projector. Since the projector and the phonograph cannot be placed side by side, one would think of connecting these two units by a flexible cable. However, in this instance, cables were impractical, in view of the distance of several meters between the two apparatus and the impracticality of using cables for the synchronization of sound and image.

For this reason an electrical transmission was designed. A dynamo with a split circuit was connected to the phonograph and its speed adjusted to the normal speed of the latter. The dynamo was connected with the projector drive motor through a rheostat mounted on the projector base. If both units were started at the same time, they ran in perfect synchronism (Fig. 1).

A contribution received on October 2, 1958, from John B. McCullough, Motion Picture Assn. of America, 28 W. 44 St., New York 36, Chairman of the Historical and Museum Committee.

The Chronophonograph

The first Chronophonograph was also presented to the Photographic Society on the same day, which gave the audience a glimpse of what they probably could expect in future meetings of the Society.

Since that time we have constantly improved distant sound recording by amplifying the emission from the phonograph, and on July 17, 1902, we presented the following films marking our introduction of sound motion pictures:

1. Introduction by Mr. Wallon
2. Lecture by Mr. D'Arsonval at the Academy of Sciences
3. *Double Tax* by Mr. R. Champigny (two persons)
4. *The Dentist* monologue by Mr. M. Zamacois
5. *Crowing Rooster*
6. *Telephone Communication* by Mr. Galipaux
7. *Banjo Player*
8. *At the Dentist's* by Mr. H. Francois (three persons)
9. *Voices of the Night* by Mr. Versse

The equipment used in this demonstration represented the results of all our previous experimentation.

The fact that the loudspeaker was placed near the projection screen, while the projector was at a great distance from it, created the necessity of additional electrical design.

Since the phonograph had to be operated at the same speed as the original recording to maintain proper

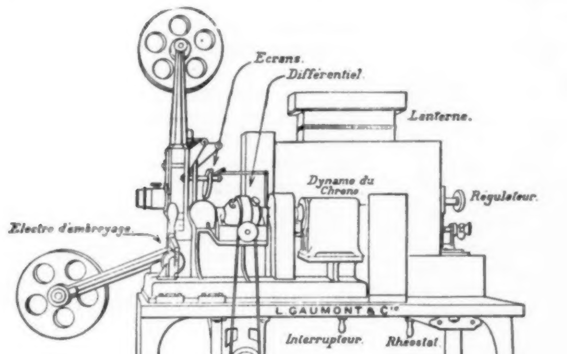


Fig. 1. Arrangement for the Chronophonograph.

Electro d'embrayage	electric clutch
Ecrans	fire shutter
Différentiel	differential
Lanterne	lamphouse
Régulateur	carbon feed
Interrupteur	switch
Dynamo du chrono	projector dynomotor
Dynamo du différentiel	differential motor

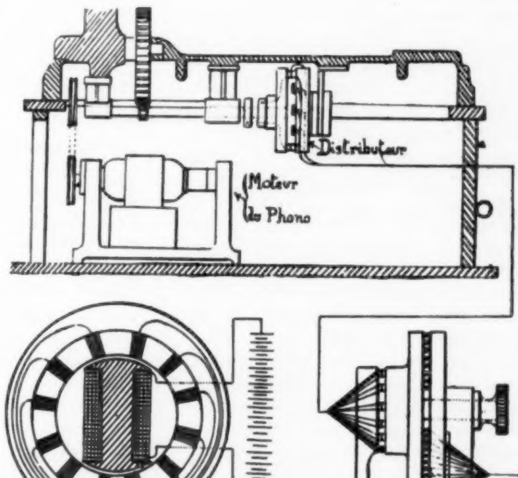


Fig. 2. The Synchronization Regulator.

Réglage de concordance	synchronization regulator
Moteur du ciné	projection motor
Moteur du phono	phonograph motor

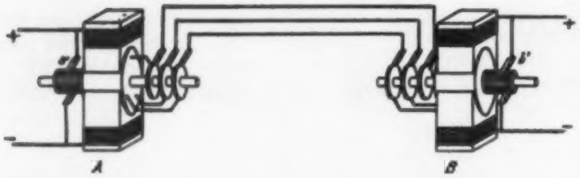


Fig. 3. Armatures of motors connected to turn at same angular displacement.

sound quality, and with the projector speed depending upon the phonograph, slight corrections, which became necessary due to the differences of one movement with respect to another, were made by means of a synchronization regulator (Fig. 2).

Several methods of connecting the apparatus were patented by our organization. One uses two small shunt d-c motors of almost the same power and supplied by the same current source.

The armatures of these motors contained the same number of sections, and each section of one armature was connected with a corresponding section of the other armature and in the same order. Consequently, the first armature turned at the same angular displacement as the second (Fig. 3).

The first armature controlled the phonograph and the second the projector. Synchronization was obtained by adjusting the speed of unwinding of the motion-picture film to the speed of the disk recording.

Some time after this presentation it was learned that the same synchronization method had been patented by E. Thompson for the operation of looms. The General Electric Co., owner of this patent, kindly granted the Gaumont Company the right to use this patent for the special purpose of obtaining synchronization of the phonograph and projector. It is, of course, understood that photography and sound recording were made simultaneously by synchronizing the sound recorder with the camera.

Synchronization of sound and image was perfect, provided the simple precaution was taken of placing the first image in the projector picture gate and at the same time the needle at the extreme start of the disk.

In later models the projector was started electrically by placing a contact on the phonograph disk. A rheostat in the motor circuit controlled the speed of both and kept the projector in accurate step with the phonograph. The speed of the latter, in turn, corresponded to the speed of the original sound recording, so that normal tone was reproduced after the speed adjustments were made.

By this method, the slightest difference between the emission of the sound and the lip movement of the actor could be easily corrected by means of the following device:

A special motor acting on a differential gear mounted on the shaft connecting the projector with the control motor could be operated in either direction by a reversing commutator. Depending on the direction of rotation of the small motor, the projector speed could be accelerated or retarded to correspond with the speed of the phonograph, until the two units were again in perfect synchronization (Fig. 1). In addition to this, a panel within reach of the operator and near the phonograph connected all controls under one button, so that the projector could be instantly started at a chosen sound produced by the phonograph. A voltmeter served as speed indicator and a multiple commutator as speed regulator (Fig. 4). Finally, a reversing commutator was used on the small motor of the differential gear.

The phonograph contained two disks which were alternately and automatically operated to assure operation for an indefinite time.

Different phonograph models were constructed in our factories for the use of disks with lateral impressions. This method gave, in fact, greater clarity and volume and permitted the needle to follow the groove more easily than the sapphire which is used in vertical position.

The Elgephone

In one of our inventions, the Elgephone, sound amplification was obtained by releasing compressed air through a double distributor. The Elgephone distributor insured a constant flow of compressed air without acting on the distributing disk, since this would be a source of distortion.

The compressed air is forced through a small tube *A* (Fig. 5) into a metallic chamber *C*. The disk *P* carrying the needle *a* vibrated between two rectangular openings 0 and 0′ following the sinuosities of the grooves on the disk by letting varying amounts of air escape through the apertures N and N′.

This method of amplification was more satisfactory than any other method known at that time. The volume was so great that the phonograph recordings could be heard in halls seating several thousand persons.

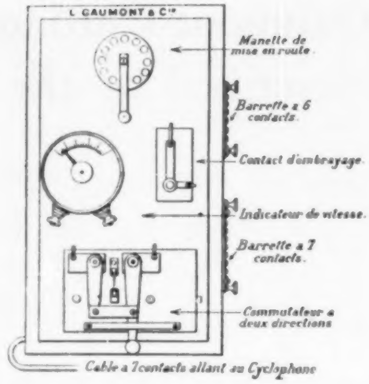


Fig. 4. Arrangement of voltmeter and multiple commutator.

Manette de mise en route	correction control
Barrette à 6–7 contacts	contact bar
Contact d'embrayage	electric clutch switch
Indicateur de vitesse	speed indicator
Commutateur à deux directions	reversing switch
Cable à 7 contacts allant au cyclophone	7-contact cable to cyclophone

Figure 6 shows the two units connected by the necessary cables, as well as the electric air compressor feeding the Elgephone.

We knew that this solution of the problem was not final at that time, because the use of the disks limited recording and reproducing possibilities. However, we were very sure that the application of sound by optical methods on film would no doubt eliminate this problem. Our tests were made on film different in dimension to the standard motion-picture film. The current modulated by the sound vibrations striking several very sensitive microphones flowed into a multistage amplifier and then into a two-wire mirror galvanometer. A very fine light beam oscillating on the film between the picture and the perforations (our film was 25mm) recorded these modulations. The speed of move-

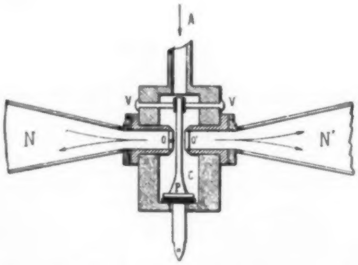


Fig. 5. Flow of compressed air through double distributor in Elgephone.

ment of this film was 500 mm/sec. This device represented the result of investigations with the Danish engineers, Petersen and Poulsen.

We experimented also with recording on two separate films, one for the image and the other for the sound. The eventual solution was the recording of sound and image on the same film strip.

Research in Color

The problem of sound recording was not the only one we studied. Our research on color motion-picture photography is recorded in history. We preferred the well-known three-color additive method used throughout all our experiments. The principle of this method was explained by Gros and Ducos de Hauron in 1869.

Each image appearing on the screen in natural colors was formed by superimposition of three images, violet, green and orange. The combined radiation of these three colors results in the reproduction of natural colors. The image was photographed on the film by three objectives placed one above the other, each provided with a glass color filter. These three images were projected in superimposition through carefully aligned objectives and filters. In this process the single image of ordinary motion pictures is replaced by three images simultaneously projected and superimposed.

If these three images had the same dimensions as used in ordinary motion pictures, 18 by 24 mm, each scene would require three times the length of film ordinarily used, and would necessitate very rapid movement of the film. Therefore, it was decided to reduce the height of the film by one quarter. By this method, the film length was approximately two and one-half times that of ordinary films.

As a further means to solve this difficulty, an intermittent movement capable of very long pulldown had to be made which was capable of transporting the film without undue strain, while guaranteeing absolutely perfect registration of the three images. The composition of the separation filters had to be carefully studied to obtain the best possible natural color rendition, especially of pure whites, by superimposition of three monochrome images. The film had to be sufficiently hypersensitized to all colors to obtain panchromatization.

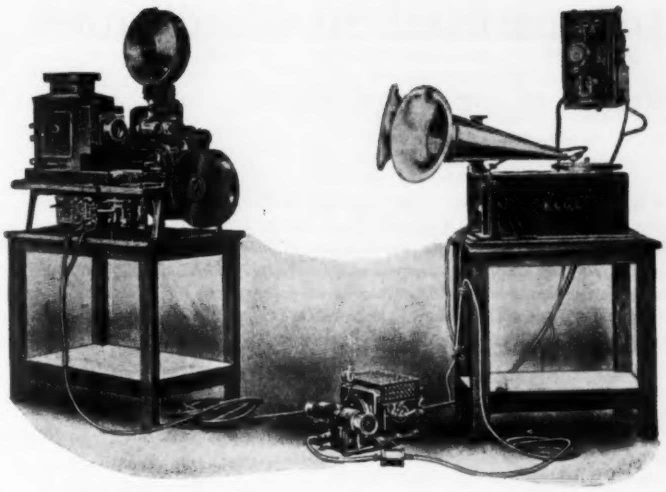


Fig. 6. The two units, with electric air compressor for Elgephone.

The following color films were projected at the general meeting of the Photographic Society on November 15, 1912:

Projections of flowers taken in the Vilmorin-Andrieux Gardens were shown, the vase containing the flowers was slowly turned giving a marvelous stereoscopic effect; projections of butterflies with brilliant colors magnificently reproduced their iridescent luster; and finally, outdoor views were shown, especially a view of the Deauville beach at the height of the social season. Other pictures showed harvesters and other very pleasant country scenes creating the impression of a sunlit countryside with the most perfect reality.

A demonstration of these three-color chronochrome motion pictures and of talking pictures was given by the U.S. branch of the Gaumont Company, at the 39th Street Theatre, New York, in June 1913. The following program was presented:

Gaumont

Chronochrome Talking Pictures

1. (a) Flower Studies
   (b) Farmyard Scenes
2. Views of the Riviera
3. *Mandolinette* — study by artificial light
4. The Nice Carnival Fetes, 1913
5. Rustic Scenes in France
6. *The Cock That Crowed in the Morn* (nature study)
7. *The Broken Window* (sketch)
8. *Justice* (illustrated fable)
9. *The Bad Son* (illustrated fable)
10. *Caught* (sketch)
11. (a) Funeral of King George of Greece, at Athens
    (b) Paris Fashions
    (c) Studies of Nature
12. *Venice* (a) town and canals
    (b) glass works. (Salviati & Co.)
13. National Flags — *The Tricolor*
    The Stars and Stripes
14. *In the Lion's Den*
15. Bert Earle, in humorous sketch
16. A French comedy entitled *Le commissaire est bon enfant* by Courteline & Levy.

International Standardization

By J. HOWARD SCHUMACHER

Report of the Third Meeting of ISO/TC 36, Cinematography

A technical report of the third meeting of ISO/TC 36, Cinematography, which was held at Harrogate, England, June 16–20, 1958. This report summarizes the history of international standardization and the deliberations and conclusions of the meeting affecting international exchange of motion-picture films and television programs. A total of 33 resolutions were adopted by TC 36. Thirteen interim working groups were constituted by ISO/TC 36 to continue the work begun at Harrogate as well as to consider new items of international concern and interest.

The origin of the International Organization for Standardization (ISO) can be traced as far back as 1926 when the International Federation of National Standardizing Associations (ISA) was constituted. The twenty member-countries which comprised the Association laid the foundation for international cooperation in the field of standardization. The work of the Association ceased officially in 1942 and was resumed by the United Nations Standards Coordinating Committee (UNSCC). This group made valuable contributions to the war effort and did a great deal to further international standardization. The members of the UNSCC and representatives of other nonmember standardizing bodies met in London in October of 1946 and unanimously adopted the ISO Constitution and Rules of Procedures. Thus, the International Organization for Standardization was born. Its present membership includes 40 countries engaged in the activities of 89 technical committees covering nearly all phases of science and engineering.

ISO Technical Committee 36, Cinematography

ISO Technical Committees are composed of delegates from each of the member bodies wishing to take part in the work of the Committee. Each technical committee has a secretariat which is responsible for the conduct of the work undertaken within the scope of the Committee. The United States (American Standards Association) is the Secretariat of Technical Committee 36 on Cinematography.

ISO/TC 36 Meetings

The first meeting was held in New York City in 1952 and the second in Stockholm in 1955. The third meeting was held in Harrogate, England, June 16–20, 1958, and was attended by 50 delegates representing twelve member-countries.

USA Delegates

The United States was represented at the 1958 meeting by E. W. D'Arcy, D'Arcy Magnetic Products; Raymond Davis, National Bureau of Standards; W. F. Kelley, Motion Picture Research Council; C. G. Mayer, Radio Corp. of America; J. G. Mulder, Eastman Kodak Co.; M. G. Townsley, Bell & Howell Co.; J. L. Tupper, Eastman Kodak Co., and Dr. D. R. White, E. I. du Pont de Nemours & Co., leader of the delegation. Mr. Paul A. Arnold, Ansco, served as chairman for the meeting. Mr. J. Howard Schumacher served as secretary.

Agenda

The 20-point agenda included subject material pertaining to film dimensions, screen luminance, magnetic sound reproduction characteristics, 35mm and 16mm camera and projector image areas, safety film, 35mm and 16mm and 8mm camera and projector spools and reels, measuring and marking of sound film, film leaders and trailers, and picture areas for television. Revision of the scope of Technical Committee 36 regarding liaison with other groups doing related work and the interests of TC 36 in new fields, such as wide-screen pictures and magnetic video recording techniques, were also discussed.

The lengthy agenda made it necessary for the chairman to appoint 11 ad hoc Harrogate Working Groups and organize them in several simultaneous sessions to study the many proposals which were submitted prior to and during the meeting. Written reports of each of the working group sessions were prepared daily by the secretarial staff, discussed by the members of TC 36, and the approved reports were used by the Resolutions Committee in drafting the resolutions.

Resolutions Adopted

The interest of the delegates and the friendly spirit of cooperation which prevailed throughout the entire meeting resulted in the unprecedented adoption of a total of 33 resolutions:

HR1. *RESOLVED that*
Draft ISO Proposals for
a. Dimensions for 35mm Motion-Picture Raw Stock, and
b. Dimensions for Double-8mm Motion-Picture Raw Stock,
be prepared by the United Kingdom on the basis of documents WG-A (UK-3) and WG-A (UK-5), amended according to the decisions of Harrogate Working Group H7, as given in their reports, and be circulated by the Secretariat to ISO/TC 36 for ballot.

HR2. *RESOLVED that*
Second Draft ISO Recommendations Nos. 69 and 70 be proceeded with, but that an Interim Working Group be constituted to commence the preparation of a new Draft ISO Proposal to embody the dimensions of all types of 16mm film in one recommendation. This new draft would cover the types of film in Draft ISO Recommendations Nos. 69 and 70, and also types 1R-2994 and 2R-2994, and such other new national standards for alternative types of 16mm film as may become available before the proposal is completed. The proposal would be prepared in the same form as that used in the Draft ISO Proposal for 35mm film dealt with in Resolution HR1.

HR3. *RESOLVED that*
The Secretariat request the ISO General Secretariat to defer further action on Draft ISO Recommendation No. 79, Image Area Produced by 16mm Camera Aperture, and that the Secretariat of ISO/TC 36 prepare and circulate to ISO/TC 36 a revised draft according to the recommendations of Harrogate Working Group H10. (See Appendix 5)

HR4. *RESOLVED that*
Working Group H11 be reconstituted as an Interim Working Group to prepare a revised Draft ISO Proposal for the Definition and Marking of Motion-Picture Safety Film, according to the decisions of Harrogate Working Group H11, and the Secretariat circulate this draft to ISO/TC 36 for ballot.

HR5. *RESOLVED that*
An Interim Working Group be constituted to study the test methods and limiting values for the total nitrate nitrogen content of all motion-picture film and also magnetic recording film as used in the trade with respect to safety of such film.

HR6. *RESOLVED that*
The Secretariat revise the Draft ISO Proposal ISO/TC 36 (59), Maximum Aspect Ratio for 35mm Wide-Screen Motion Pictures, according to the recommendations of Harrogate Working Group H13 in their report and circulate this revised proposal to ISO/TC 36 for ballot. (See Appendix 9)

HR7. *RESOLVED that*
The Secretariat revise Swedish document G26 covering 35mm film: image area of

A report prepared by J. Howard Schumacher, SMPTE Staff Engineer; Secretary, ISO/TC 36 Harrogate 1958 Meeting.

anamorphic pictures (lateral compression ratio 2:1, aspect ratio 2.35:1), according to the recommendations of Harrogate Working Group H13 in their report and circulate this draft to ISO/TC 36 as a Draft ISO Proposal for ballot. (See Appendix 10)

HR8. *RESOLVED that*
An Interim Working Group be constituted to prepare Draft ISO Proposals relating to the image areas and sound record dimensions of 35mm release prints for wide-screen presentation having four magnetic tracks and one optical track, based on Swedish document G29, and to investigate and report on the desirability of preparing a Recommendation for a multitrack 35mm release print for universal use as proposed by the USSR.

HR9. *RESOLVED that*
The Secretariat revise Swedish document G28 for two-track magnetic and full-width optical track sound release prints for 35mm film, according to the recommendations of Harrogate Working Group H13 in their report and circulate this draft to ISO/TC 36 as a Draft ISO Proposal for ballot. (See Appendix 11)

HR10. *RESOLVED that*
The Secretariat revise Swedish document G27 for four-track magnetic sound release prints for 35mm film, according to the recommendations of Harrogate Working Group H13 in their report and circulate this draft to ISO/TC 36 as a Draft ISO Proposal for ballot. (See Appendix 12)

HR11. *RESOLVED that*
The Secretariat circulate to ISO/TC 36 for ballot the revised Draft ISO Proposal for Magnetic Striping on 16mm Motion-Picture Film Perforated Along One Edge, as prepared by Harrogate Working Group H12. (See Appendix 7)

HR12. *RESOLVED that*
The Secretariat circulate to ISO/TC 36 for ballot the revision of Modified Draft ISO Proposal ISO/TC 36 (56), Location of Recording Heads for Four Magnetic Sound Records on 35mm Film, as prepared by Harrogate Working Group H12. (See Appendix 8)

HR13. *RESOLVED that*
The Secretariat advise the General Secretariat that ISO/TC 36 recommends that Draft ISO Recommendation No. 199, Three-Track Recording on 35mm Film, be edited so that the title of Section 2 and the explanatory note on the inch and millimeter dimensions are in the same form as that adopted under Resolution HR12 for the Draft ISO Proposal for four-track recording.

HR14. *RESOLVED that*
The draft proposal for center and edge track recording on 16mm film, prepared by the Chairman of Harrogate Working Group H12, be referred to an Interim Working Group for action.

HR15. *RESOLVED that*
The Secretariat be directed to make investigations about the interest among the participating members of ISO/TC 36 in standardization of "Big-Screen Systems" and "Set of Materials Necessary for the International Exchange of Films," in accordance with the report of ad hoc Working Group H15 and refer the preparation of proposals to Interim Working Groups if sufficient interest warrants it.

HR16. *RESOLVED that*
An Interim Working Group be constituted to report upon the interest of ISO/TC 36 in "Video Tape Recording" and whether action and/or coordination with other interested bodies is desirable.

HR17. *RESOLVED that*
The Secretariat request the ISO General Secretariat to defer further action on Draft ISO Recommendation No. 80, 16mm Film Projected Image Area, and that the Secretariat of ISO/TC 36 circulate to ISO/TC 36 for ballot the revised draft prepared by Harrogate Working Group H10. (See Appendix 6)

HR18. *RESOLVED that*
The Secretariat circulate to ISO/TC 36 for ballot a Draft ISO Proposal, Recorded Characteristic for Magnetic Sound Records on 16mm Perforated Film, as prepared by Working Group H9. (See Appendix 3)

HR19. *RESOLVED that*
The Secretariat circulate to ISO/TC 36 for ballot a Draft ISO Proposal, Recorded Characteristic for Magnetic Sound Records on 35mm Perforated Film, as prepared by Working Group H9. (See Appendix 4)

HR20. *RESOLVED that*
The Secretariat continue active liaison with IEC/TC 29, Electro-Acoustics, and circulate as Draft ISO Proposals

a. Recorded Characteristic for Magnetic Sound Records on 16mm Perforated Film, and
b. Recorded Characteristic for Magnetic Sound Records on 35mm Perforated Film

to the Secretariat of IEC/TC 29. Further, that comments, if any, from IEC/TC 29 shall be considered by the Secretariat of ISO/TC 36 in the further processing of these proposals.

HR21. *RESOLVED that*
An Interim Working Group be appointed to continue the work on the recorded frequency characteristic for magnetic recordings on 35mm and 16mm perforated film, and that the Secretariat be requested to maintain liaison with the work of IEC/TC 29.

HR22. *RESOLVED that*
The Chairman of the Interim Working Group dealing with the recorded frequency characteristic for magnetic recordings on 35mm and 16mm perforated film be authorized to correspond with a suitable person designated by the Secretariat of IEC/TC 29 during the preliminary stages of the formulation of further documents in this field.

HR23. *RESOLVED that*
An Interim Working Group be constituted to prepare Draft ISO Proposals for

a. Synchronization Marks for Leaders for Studio Use;
b. Numbering of 17.5 and 35mm Magnetic Sound Prints;
c. Leaders and Trailers for Release Prints.

HR24. *RESOLVED that*
Draft ISO Proposal ISO/TC 36 (20), Luminance of White Matte Screens for 35mm Projection, be withdrawn, and that the Secretariat circulate to ISO/TC 36 for ballot the new proposal prepared by Harrogate Working Group H8 to embrace all types of screens and covering both 35mm and 16mm films—Luminance of Screens for 35mm and 16mm Projection in Indoor Theaters. (See Appendix 1)

HR25. *RESOLVED that*
The Secretariat circulate to ISO/TC 36 for ballot as a Draft ISO Proposal, Luminance of Screens for 35mm Projection in Review Rooms, prepared by Harrogate Working Group H8. (See Appendix 2)

HR26. *RESOLVED that*
An Interim Working Group be constituted to continue discussions commenced by Harrogate Working Group H8 on the subjects of

a. the distribution of luminance over directional screens for all places in the theater other than the center of the hall;
b. luminance of screens for 16mm review rooms;
c. methods of measuring stray light on theater screens; and
d. any other questions concerning screen luminance as related to a, b or c above.

HR27. *RESOLVED that*
An Interim Working Group be constituted to prepare Draft ISO Proposals for the items listed below:

a. 8mm Camera Spools (based on Draft German Standard DIN 15822);
b. 16mm Camera Spools for 15 m (50 ft), 30 m (100 ft), and 60 m (200 ft) Capacities;
c. Film Cores for All Sizes of Perforated Motion-Picture and Magnetic Film;
d. Designation of Direction of Winding on Spools and Cores of Film Perforated Along One Edge (based on American Standard PH22.75-1953);
e. Projection Reels for 8, 16, and 35mm Films.

In addition, the Secretariat shall arrange for liaison representatives from ISO/TC 42, Photography, and ISO/TC 46, Documentation.

HR28. *RESOLVED that*
The Secretariat shall arrange that the Interim Working Group constituted under Resolution HR27 shall be represented on ISO/TC 46/SC 1, Documentary Reproduction, to assist in the preparation of a Draft ISO Proposal for 30 m (100 ft)-Capacity 35mm Camera Spools.

HR29. *RESOLVED that*
Resolution HR1 be supplemented to include reference to the second Working Group H7 Report in addition to the first report. (The directions as per this resolution have been incorporated in Resolution HR1 as presented herewith.)

HR30. *RESOLVED that*
Working Group H7 be reconstituted as an Interim Working Group to prepare a Draft ISO Proposal for the Definition of Filmmeter and Filmfoot, based on Swedish document ISO/TC 36 Harrogate 99B-HP1, in conjunction with comments to be submitted by members of the Working Group.

HR31. *RESOLVED that*
A Working Group be set up under Resolu-

tion HR2 to commence the preparation of a new Draft ISO Proposal for Sprockets for 35mm Projectors, based on French Standard 26-008, giving first priority to a sprocket suitable for use with film having any type of perforation designated in the Draft ISO Proposal, Dimensions for 35mm Raw Stock, to be prepared in accordance with Resolution HR1; and second priority to be given to a sprocket specially designed for the Type 1 perforation.

HR32. *RESOLVED that*

An Interim Working Group be constituted to continue the discussion commenced by Harrogate Working Group H18 as outlined in their report and to prepare Draft ISO Proposals for the Picture Areas of Motion-Picture Films and Slides for Transmission by Television.

HR33. *RESOLVED that*

The Third Plenary Session of ISO/TC 36 which met at Harrogate June 16 to 20, 1958, extend heartfelt thanks to the British Standards Institution, hosts on this occasion, for their thoughtful organization, efficient service, and friendly hospitality which made the work so pleasant and successful.

Draft ISO Proposals

Twelve proposals drafted during the meeting will be circulated by the Secretariat to the members of TC 36 for their consideration and comment:

Luminance of Screens for 35mm and 16mm Projection in Indoor Theaters (See Appendix 1)

Luminance of Screens for 35mm Projection in Review Rooms (See Appendix 2)

Recorded Characteristic for Magnetic Sound Records on 16mm Perforated Film (See Appendix 3)

Recorded Characteristic for Magnetic Sound Records on 35mm Perforated Film (See Appendix 4)

16mm Film Image Produced by Camera Aperture (See Appendix 5)

16mm Film Projected Image Area (See Appendix 6)

Magnetic Striping on 16mm Motion-Picture Film Perforated Along One Edge (See Appendix 7)

Location of Recording Heads for Four Magnetic Sound Records on 35mm Film (See Appendix 8)

Maximum Aspect Ratio for 35mm Wide-Screen Non-Anamorphotic Motion Pictures (See Appendix 9)

35mm Film Image Area for Anamorphic Pictures with Lateral Compression Ratio of 2:1 and Aspect Ratio of 2.35:1 (See Appendix 10)

35mm Film, Single-Track Magnetic Optical Sound for Release Prints (See Appendix 11)

35mm Film, Four-Track Magnetic Sound for Release Prints (See Appendix 12)

Interim Working Groups

Thirteen interim working groups were constituted by ISO/TC 36 at the conclusion of the Harrogate meeting. A number of these groups were asked to continue the deliberations begun at Harrogate but not completed due to lack of time. Other interim working groups will consider items of new business such as technical recommendations concerning international exchange of films and co-productions and a reviving of former international standards activity leading toward a single standard for the dimension and shape of film perforations.

The titles and composition of the working groups may be found in Appendix 13.

Completed Projects

To facilitate the international exchange of motion pictures and television programs on film, the following ISO Recommendations have received official approval*:

ISO/R 23, Emulsion and Sound Record Positions in Camera for 35mm Sound Motion Picture Film

ISO/R 24, Emulsion and Sound Record Positions in Projector for 35mm Sound Motion Picture Film

ISO/R 25, Emulsion Position in Camera for 16mm Silent Motion Picture Film

ISO/R 26, Emulsion Position in Projector for Direct Front Projection of 16mm Silent Motion Picture Film

ISO/R 27, Emulsion and Sound Record Positions in Camera for 16mm Sound Motion Picture Film

ISO/R 28, Emulsion Position in Camera for 8mm Silent Motion Picture Film

ISO/R 29, Emulsion Position in Projector for Direct Front Projection of 8mm Silent Motion Picture Film

ISO/R 69, Dimensions for 16mm Motion Picture Film (with Perforations Along One and Two Edges)

ISO/R 70, Photographic Sound Record on 35mm Prints

ISO/R 71, Photographic Sound Record on 16mm Prints

ISO/R 72, Sound Records and Scanning Area of 35mm Double-Width Push-Pull Sound Prints (Normal and Centerline Types)

ISO/R 73, Image Produced by Camera Aperture and Projected Image Area for 35mm Film

ISO/R 74, Image Produced by Camera Aperture and Projected Image Area for 8mm Film

Conclusion

The Society is indebted to the following companies for permitting their personnel to attend the ISO meeting as U.S. Delegates: Ansco, Bell & Howell, D'Arcy Magnetic Products, E. I. du Pont de Nemours & Co., Eastman Kodak Co., Motion Picture Research Council, National Bureau of Standards and Radio Corp. of America. The delegates were successful in promoting several of the 11 American Standards, which were among the 40 documents offered for consideration and discussion at the meeting, as the basis for future ISO Recommendations. Society members should feel a sense of pride that their Society, as sponsor of all American Standards relating to cinematography, was instrumental in providing the foundation for the international acceptance of many of our industry's practices. The members of the Society are urged to share responsibility with the SMPTE engineering committee members who draft American Standards. Careful review of the proposals when they are published in the *Journal* for trial and comment will enable the Society to insure technical accuracy as well as consistency with current American industry practices.

International interest and participation in standardization are increasing, particularly with respect to the exchange of motion-picture release prints and television film programs. Our standards, to be considered abroad, must be used and accepted in our own country. Therefore, industry is urged to refer to American Standards whenever possible. If the U. S. is to remain the recognized authority on cinematography, the Society must be provided with the technical and financial assistance which it needs in order to carry out effectively its assigned task as originator and sponsor of American Standards.

* ISO Recommendations R23-29 were published in the December 1957 *Journal* and are available from the American Standards Association, Inc., 70 East 45 St., New York 17.

Appendix 1. Luminance of Screens for 35mm and 16mm Projection in Indoor Theaters.

1. SCOPE

1.1 This proposal specifies the luminance of screens employed in the viewing of projected 35mm and 16mm motion pictures for all types of screens in indoor theaters.

1.2 The determination of the specified luminance is made with the projector in operation but with no film in the gate.

2. LUMINANCE LEVEL

2.1 The luminance at any part of the screen shall be between 25 and 65 nits as measured from any seat in the auditorium.

3. LUMINANCE DISTRIBUTION

3.1 *Matte Screens.* The luminance at a distance 5 percent of screen width from the side edges of the screen and on its horizontal axis shall lie between 65 percent and 85 percent of the center luminance. These limits apply to measurements made from all seats in the auditorium.

3.2 *Directional Screens.* The luminance at a distance 5 percent of screen width from the side edges of the screen and on its horizontal axis shall lie between 65 percent and 85 percent of the center luminance. These limits apply only to measurements made from the center of the main floor.

4. MEASUREMENT

4.1 The screen luminance shall be measured with a photometer having an accept-

ance angle not greater than 2 degrees and having the spectral sensitivity of a Standard Observer as specified by the International Commission on Illumination, 1931.

Appendix 2. Luminance of Screens for 35mm Projection in Review Rooms.

1. SCOPE

1.1 This proposal specifies the luminance of screens employed in the viewing of projected 35mm motion pictures for all types of screens in review room theaters.

1.2 The determination of the specified luminance is made with the projector in operation but with no film in the gate.

2. LUMINANCE LEVEL

2.1 The luminance at the center of the screen measured from the center of the area occupied by the seats shall lie between 40 and 50 nits.

3. LUMINANCE DISTRIBUTION

3.1 The luminance at a distance 5 percent of screen width from the side edges of the screen and in its horizontal axis shall lie between 75 percent and 85 percent of the center luminance. Measurements shall be made from the position defined in 2.1.

4. MEASUREMENT

4.1 The screen luminance shall be measured with a photometer having an acceptance angle not greater than 2 degrees and having the spectral sensitivity of a Standard Observer as specified by the International Commission on Illumination, 1931.

Appendix 3. Recorded Characteristic for Magnetic Sound Records on 16mm Perforated Film.

1. SCOPE

1.1 This proposal specifies the recorded characteristic for magnetic sound records on 16mm magnetic film and 16mm motion-picture film with magnetic striping.

2. RECORDED CHARACTERISTIC

2.1 With constant voltage applied to the input of the recording chain, the curve of recorded surface induction versus frequency shall rise with increasing frequency in conformity with the admittance of a series combination of a capacitance and a resistance having a time constant of 100 microseconds. Approximate numerical values are given in Table 1.

Table 1

c/s Hertz	*35 micro-seconds db*	*c/s Hertz*	*35 micro-seconds db*
40	−31.95	2000	−2.1
50	−30.0	3000	−1.0
60	−28.45	4000	−0.6
100	−24.0	5000	−0.35
200	−18.05	6000	−0.25
300	−14.6	7000	−0.15
400	−12.3	8000	−0.12
500	−10.4	9000	−0.08
700	− 7.85	10000	−0.06
1000	− 5.45	12000	−0.03
1570	− 3.0	15000	0

2.2 The corresponding reproducing characteristic is that which gives a flat response when reproducing a sound track recorded with the relative surface induction levels stated in 2.1.

3. TOLERANCES

3.1 Magnetic sound records on films for the exchange of television programs shall be recorded to the characteristic specified under 2.1, within the tolerances given in Fig. 1.

3.2 In the case of sound records primarily intended for reproduction on portable equipment, the tolerances of Fig. 2 may be applied instead of the tolerances of Fig. 1.

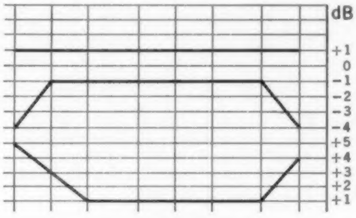


Figure 1

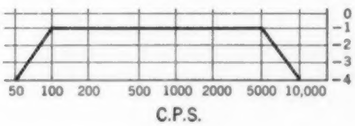


Figure 2

Tolerances on recorded levels 16mm film.

Appendix 4. Recorded Characteristic for Magnetic Sound Records on 35mm Perforated Film.

1. SCOPE

1.1 This proposal specifies the recorded characteristic for magnetic sound records on 35mm magnetic film and 35mm motion-picture film with magnetic striping.

2. RECORDED CHARACTERISTIC

2.1 With constant voltage applied to the input of the recording chain, the curve of recorded surface induction versus frequency shall rise with increasing frequency in conformity with the admittance of a series combination of a capacitance and a resistance having a time constant of 35 microseconds. Approximate numerical values are given in Table 1.

Table 1

c/s Hertz	*35 micro-seconds db*	*c/s Hertz*	*35 micro-seconds db*
40	−40.75	3000	−4.8
50	−38.8	4000	−3.2
60	−37.2	4550	−3.0
100	−32.75	5000	−2.25
200	−26.75	6000	−1.6
300	−23.25	7000	−1.15
400	−20.8	8000	−0.85
500	−18.85	9000	−0.6
700	−15.95	10000	−0.45
1000	−13.0	12000	−0.2
2000	− 7.5	15000	0

2.2 The corresponding reproducing characteristic is that which gives a flat response when reproducing a soundtrack recorded with the relative surface induction levels stated in 2.1.

3. TOLERANCES

3.1 Magnetic sound records on films for the exchange of television programs shall be recorded to the characteristic specified under 2.1, within the tolerances as given in Fig. 1.

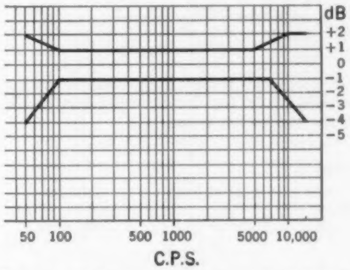
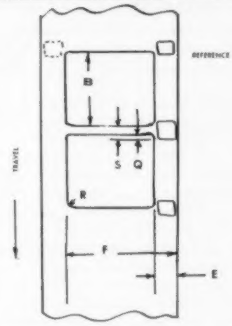


Fig. 1. Tolerances on recorded levels 35mm film.

Appendix 5. 16mm Film Image Produced by Camera Aperture (To replace Draft ISO Recommendation No. 79).



The image produced on the film shall be in accordance with the dimensions given on the figure and in the table. The dimensions are shown relative to unshrunk film.

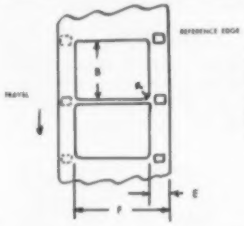
Dimension	*Millimeters*	*Inches*
B	7.44 + 0.16 − 0.0	0.293 + 0.006 − 0.0
E	2.95 max	0.116 max
F	13.00 + 0.15 − 0.0	0.512 + 0.006 − 0.0
Q	0.46 min	0.018 min
R	0.5 max	0.02 max
S	0.80 max	0.032 max

Note 1: Dimensions B, E, F, and R apply to the size of the image at the plane of the emulsion; the camera aperture has to be slightly smaller. The exact amount of this difference depends on the lens used (whether of short focal length and/or large diameter) and on the separation of the emulsion and the aperture plate. This separation should be no larger than is necessary to preclude scratching of the film.

Note 2: It is desirable that the camera viewfinder should show an image area corresponding with that which will subsequently be projected.

Note 3: The dimensions given will result in a minimum usable image area of 10.05 × 7.44 mm (0.396 × 0.293 in.).

Appendix 6. 16mm Film Projected Image Area (To replace Draft ISO Recommendation No. 80).



Film as seen from inside the projector looking toward the lens.

The projected image area shall be in accordance with the dimensions given in the figure and in the table.

Dimension	*Millimeters*	*Inches*
B	7.26 + 0.0 − 0.20	0.286 + 0.0 − 0.008
E	3.1 + 0.1 − 0.0	0.122 + 0.004 − 0.0
F	12.8 + 0.0 − 0.1	0.504 + 0.0 − 0.004
R	0.5 max	0.02 max

The angle between the vertical edges of the aperture and the edges of normally positioned film shall be 0 ± 1/2 degree.

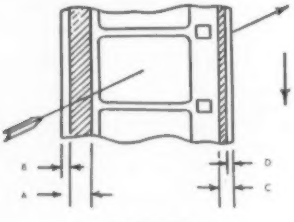
The angle between the horizontal edges of the aperture and the edges of normally positioned film shall be 90 ± 1/2 degrees.

Note 1: Dimensions A, B, and R apply to the size of the projected area of the image; corresponding dimensions of the projector aperture are actually slightly smaller. The difference depends upon the lens used and the space provided between the surface of the emulsion and that of the aperture in order to avoid scratching. This space should be kept as small as possible so that the image of the edges of the aperture will be relatively sharp. A lens with a 50mm focal length and $f/1.4$ is considered as normal for these computations.

Note 2: The projector aperture generally is located between the film and the light source in order to assure the maximum protection from heat; in certain cases, however, an opposite arrangement can be adopted.

Note 3: The dimensions E and F are so chosen as to center the image on film which is slightly shrunk at the time it is projected, which conforms with normal operating conditions.

Appendix 7. Magnetic Striping on 16mm Motion-Picture Film Perforated Along One Edge.



1. SCOPE

1.1 This proposal specifies the location and dimensions of the magnetic stripes on 16mm motion-picture film, perforated along one edge, to be used for both picture and sound.

2. DIMENSIONS

2.1 The dimensions are as specified in the diagram and table.

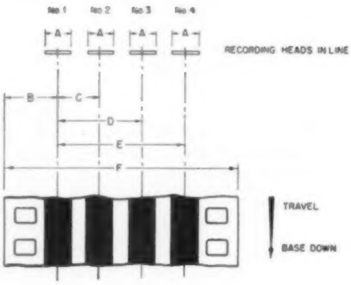
2.2 The magnetic coating is on the side of the film toward the lamp of a projector arranged for direct projection on a reflection-type screen.

2.3 The magnetic sound record on the film precedes the center of the corresponding picture by a distance of 28 frames ± one-halfframe.

Dimension	*Millimeters*	*Inches*
A	2.5 + 0.15 − 0.0	0.100 + 0.004 − 0.002
B	0.15 max	0.005 max
C	0.8 + 0.0 − 0.1	0.031 + 0.0 − 0.003
D	0.05 max	0.002 max

Note: If the magnetic stripe increases the thickness of the film, a balance stripe is applied to equalize the thickness of the two edges of the film. The balancing stripe has the dimensions shown in the diagram and table.

Appendix 8. Location of Recording Heads for Four Magnetic Sound Records on 35mm Film.



1. SCOPE

1.1 This proposal specifies the location and dimensions of four magnetic sound records on 35mm film.

2. DIMENSIONS

2.1 The dimensions are as specified in the diagram and table.

3. MAGNETIC COATING

3.1 With the direction of the film travel shown in the diagram, the magnetic coating is on the upper face of the film base.

Dimension	*Millimeters*	*Inches*
A	3.8 + 0.1 − 0.0	0.150 + 0.004 − 0.0
B	7.9 ± 0.05	0.314 ± 0.002
C	6.4 ± 0.05	0.250 ± 0.002
D	12.8 ± 0.05	0.500 ± 0.002
E	19.2 ± 0.05	0.750 ± 0.002

Note: The millimeter and inch dimensions represent acceptable practice though the positions of the outer tracks differ slightly in the two systems. The advantages of round numbers in both systems justify the differences.

Appendix 9. Maximum Aspect Ratio for 35mm Wide-Screen Non-Anamorphotic Motion Pictures.

1. SCOPE

1.1 This proposal specifies the maximum aspect ratio for the projection of wide-screen non-anamorphotic motion pictures from 35mm film with normal format images (camera image 22mm × 16mm, 0.868 in. × 0.631 in.).

1.2 The position of the projector aperture relative to the image printed on the film is also specified.

1.3 This proposal excludes anamorphotic techniques.

2. ASPECT RATIO

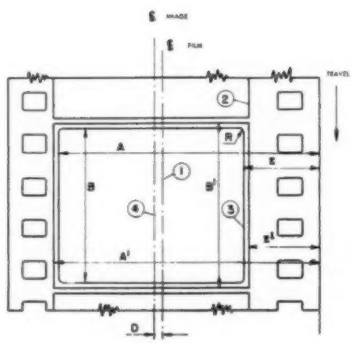
2.1 The maximum aspect ratio of the projector aperture shall be 1.85:1 (see note).

3. POSITION OF PROJECTOR APERTURE

3.1 For all wide-screen aspect ratios up to the maximum of 1.85:1, the edge of the projector aperture which corresponds to the upper edge of the picture as seen on the screen shall be 1.7 mm (0.067 in.) from the edge of the normal format image printed on the film.

Note: This ratio will represent the proportions of the picture on the screen only when projection is at right angles to the screen.

Appendix 10. 35mm Film Image Area for Anamorphic Pictures With Lateral Compression Ratio of 2:1 and Aspect Ratio of 2.35:1.



1 = centerline of film
2 = printed image
3 = projected image
4 = vertical centerline of image and of projector aperture

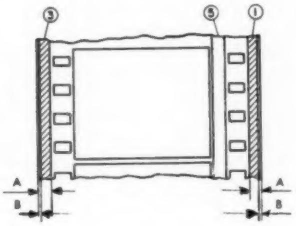
Film as seen from the position of the projector light source, looking toward the lens. The dimensions are shown relative to unshrunk film.

(*See table on page 37*)

Dimension	Millimeters	Inches
A	29.4 max	0.839 max
B	18.15 max	0.715 max
A^1	29.75 min	0.868 min
B^1	18.7	0.735
D*	1.24	0.049
R**	0.15 max	0.006 max
E	8.1 min	0.319 min
E^1	7.75 ± 0.05	0.304 ± 0.002

* Dimension D is determined from other standardized dimensions.
** Radius of corners.

Appendix 11. 35mm Film, Single-Track Magnetic Optical Sound for Release Prints.



Dimensions for coating on unshrunk raw stock.
Magnetic coating down.
Emulsion up.

Dimension	Millimeters	Inches
A	1.80 ± 0.1	0.071 ± 0.004
B	0.20 ± 0.05	0.008 ± 0.002
5	For optical soundtrack dimensions, see D/ISO/R72	

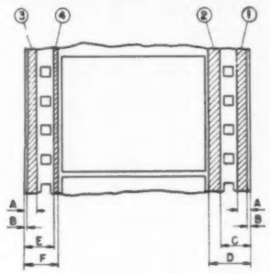
Soundtracks

The magnetic track shall be recorded on stripe No. 1 and may contain the same sound as the optical track or another sound, e.g., a version in another language.

Distance between sound and corresponding picture: The magnetic sound shall succeed the center of the corresponding picture by a distance of 28 frames.

Note 1: The stripe No. 3 may be used for a second magnetic soundtrack or as a balance stripe only.
Note 2: All 35mm magnetic soundtracks shall be playable on the same equipment.

Appendix 12. 35mm Film, Four-Track Magnetic Sound for Release Prints.



Coating on unshrunk raw stock.

1. Stripe No. 1
2. Stripe No. 2
3. Stripe No. 3
4. Stripe No. 4

Magnetic coating down.
Emulsion up.

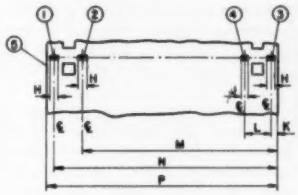
Dimension	Millimeters	Inches
A	1.80 ± 0.1	0.071 ± 0.004
B	0.20 ± 0.05	0.008 ± 0.002
C	4.56 ± 0.1	0.1795 ± 0.004
D	6.16 ± 0.1	0.2425 ± 0.004
E	4.33 ± 0.1	0.1705 ± 0.004
F	5.30 ± 0.1	0.2085 ± 0.004

Soundtracks

For stereophonic sound the stripes shall be used as follows:

Stripe No. 1 Track with sound for right channel
Stripe No. 2 Track with sound for center channel
Stripe No. 3 Track with sound for left channel
Stripe No. 4 Track with sound for effects (and control signals)
(Channel nomenclature: audience subjective)

Distance between sound and corresponding pictures: The sound shall succeed the center of the corresponding picture by a distance of 28 frames.



Reproducing heads for shrunk film.

1. Head No. 1 for stripe No. 1
2. Head No. 2 for stripe No. 2
3. Head No. 3 for stripe No. 3
4. Head No. 4 for stripe No. 4
5. Guided edge

Usage in projector is specified by ISO/R 24.
Magnetic coating down.
Emulsion up.
Recording heads in line.
(The heads are seen through the film.)

Dimension	Millimeters	Inches
H	1.25	0.059
J	0.97	0.036
K	1.00	0.040
L	4.32	0.170
M	29.10	1.146
N	32.90	1.295
P	34.90 ± 0.05	1.374 ± 0.002

Note 1: The dimensions for the reproducing sound heads are shown for film that has shrunk 0.2 percent which corresponds to low shrinkage safety-type release prints as used in the theater. (These dimensions do not apply to recording heads or to reproducing heads for unshrunk film.)
Note 2: All 35mm magnetic soundtracks shall be playable on the same equipment.

Appendix 13. Interim Working Groups.

Designation	Harrogate Resolution No.	Title	Belgium	Canada	Czechoslov.	France	Germany	Japan	Netherlands	Rumania	Sweden	United King.	USA	USSR
Interim Working Group H	2	Film Dimensions	X	—	X	X	X	X	—	—	—	C	X	X
Interim Working Group I	26	Luminance of Screens	—	—	X	C	X	X	—	X	X	X	X	X
Interim Working Group J	21	Magnetic Sound Reproduction	—	X	X	X	X	—	X	—	X	X	C	—
Interim Working Group K	4, 5	Definition and Marking of Motion-Picture Safety Film	C	—	—	X	X	X	—	—	—	X	X	X
Interim Working Group L	14	Locations and Dimensions of Magnetic Soundtracks	—	X	X	X	C	—	X	—	X	X	X	X
Interim Working Group M	8	Wide-Screen Motion Pictures	—	X	X	X	X	—	X	X	C	X	X	X
Interim Working Group N	27	Film Spools and Cores	X	X	—	X	X	X	X	—	X	X	C	X
Interim Working Group O	16	Rules Committee	—	X	X	X	X	—	X	—	X	X	C	X
Interim Working Group P	23	35mm and 16mm Film Leaders and Trailers	—	—	—	X	X	—	—	—	C	X	X	X
Interim Working Group Q	32	Picture Areas of Films for Television	—	X	—	X	X	—	X	—	X	C	X	X
Interim Working Group R	30	Definition of "Filmmeter" and "Filmfoot"	X	—	X	X	X	X	—	—	X	C	X	X
Interim Working Group S	31	35mm Projector Sprockets	—	—	X	X	X	X	—	—	—	C	X	X

Note: "C" indicates Chairman of Interim Working Group. "X" indicates Member of Interim Working Group.

motion-picture standards

Two American Standards

Published here are American Standards PH22.31-1958, Motion Picture Safety Film, and PH22.113-1958, 16mm Flutter Test Film, Magnetic Type, which were approved by the American Standards Association on December 10, 1958.

PH22.31, a revision of Z22.31-1946, and PH22.113 had their trial publication in the February 1958 Journal. Subsequently, editorial modifications of both standards were proposed and approved and are incorporated in these final drafts. Paragraph 1.1 of PH22.31 has been changed to simplify the scope. This final draft of PH22.113 differs from that published for trial and comment in that the diagram has been changed, a table of dimensions has been added and the Appendix has been reworded for clarification. A test film produced in accordance with these specifications is available from Society Headquarters.—*J. Howard Schumacher*, Staff Engineer.

American Standard

Motion-Picture Safety Film

ASA Reg. U.S. Pat. Off.
PH22.31-1958
Revision of Z22.31-1946
*UDC 778.5:771.523

1. Scope

1.1 This standard specifies and defines safety film as applied to motion-picture film.

1.2 The notes are a part of the standard.

2. Safety Film

2.1 The term "safety film" as applied to motion-picture film shall comply with American Standard PH1.25-1956, Specifications for Safety Photographic Film, or the latest revision thereof approved by the American Standards Association, Incorporated.

2.2 All motion-picture and magnetic film, regardless of width, shall be manufactured so as to meet the definition of safety photographic film.

2.3 Only safety film shall be made available for and used in 16mm and 8mm motion-picture cameras and projectors.

NOTES

1. 35mm nitrate motion-picture film is no longer manufactured in the U.S. However, there are existing nitrate films still in use or in storage and there are others existing or of future manufacture which may be imported. There is no intent in this standard to limit the use of such 35mm nitrate films, but by designating them as "nonstandard" it is intended to emphasize that the hazard involved in their handling requires the observance of adequate precautions and safeguards. (See "Standards of the National Board of Fire Underwriters for Storage and Handling of Cellulose Nitrate Motion Picture Film as Recommended by the National Fire Protection Association," NBFU Pamphlet No. 40, November 1953.)

2. Nitrate film, because of its attendant fire hazards, has never been manufactured in the U.S. in the 16mm and 8mm widths since these are traditionally for amateur and nontheatrical use. However, small quantities of nitrate film may be in existence as a result of foreign import or from slitting operations of certain intermediate laboratory processing films. The purpose of ¶2.3 is therefore to classify and designate as nonstandard the handling or use of all such film.

Approved December 10, 1958, by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

*Universal Decimal Classification

Printed in U.S.A.
ASA%M150/35

American Standard

16mm Flutter Test Film, Magnetic Type

ASA Reg. U.S. Pat. Off.
PH22.113-1958
*UDC 778.5:771.531.551.2

1. Scope

1.1 This standard specifies a 3000 cps magnetic sound test film for use in determining the presence of flutter in 16mm magnetic sound reproducers.

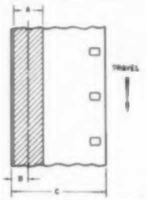
2. Test Film

2.1 The test film shall have an originally recorded, 200-mil width, magnetic sound record as shown in the drawing. The location and dimensions shall be in accordance with American Standard PH22.97-1956, 200-Mil Magnetic Sound Record on 16mm Film Base, Perforated One Edge, or the latest revision thereof approved by the American Standards Association, Incorporated.

2.2 The recorded frequency shall be 3000 ± 25 cps with a film rate of 24 perforations per second (approximately 36 ft per minute).

2.3 The recording shall be made at 100% modulation level with a tolerance of +0 —2 db. 100% modulation is defined as the recording-head current at which 3% total harmonic distortion occurs at a signal frequency of 1000 cps.

2.4 The total rms flutter of the sound recorder shall not exceed 0.1% and the flutter amplitude, at any single flutter rate, shall not exceed 0.05% (as defined in American Standard Z57.1-1954, Method of Determining Flutter Content of Sound Recorders and Reproducers, or the latest revision thereof approved by the American Standards Association, Incorporated).



Dimension	Inches	Millimeters
A	0.200 ± 0.002	5.08 ± 0.05
B	0.103 ± 0.002	2.62 ± 0.05
C	0.630 nom	16 nom

3. Film Stock

3.1 The film stock shall be of the low-shrinkage safety type, cut and perforated in accordance with American Standard PH22.12-1953, Dimensions for 16mm Film, Perforated One Edge, or the latest revision thereof approved by the American Standards Association, Incorporated.

4. Length of Film

4.1 The film shall be supplied in 100-ft and 400-ft lengths.

5. Identification

5.1 The film shall have identification markings at both ends.

Note: A test film produced in accordance with this standard is available from the Society of Motion Picture and Television Engineers.

APPENDIX

(This Appendix is not a part of American Standard 16mm Flutter Test Film, Magnetic Type, PH22.113-1958, but is included to facilitate its use.)

It is recognized that there are certain desirable features in a test film of this kind that will simplify its use in measuring flutter. Because of the variety of flutter-measuring meters, one such feature is reasonable uniformity of the level of reproduction throughout the length of the test film. Therefore, it is recommended that the variations in the output level throughout the length of the test film as measured by a VU-type meter shall be less than ± 1 db.

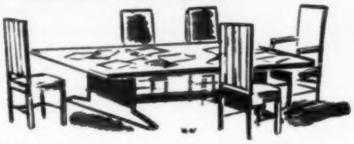
Short-term level variations, as for example those resulting from drop-outs, may cause some difficulty in the use of this film. Since these do not lend themselves to precise manufacturing specifications, maximum care should be exercised in the preparation of this film to minimize these variations.

Approved December 10, 1958, by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

*Universal Decimal Classification

Printed in U.S.A.
ASA%M150/35

engineering activities



This report is a brief résumé of major topics discussed and projects reviewed during meetings of the Engineering Committees at the Society's 84th Convention.

Film Dimensions

The meeting was devoted to items of new business and to a report of the recent International Standards meeting on items of interest to committee members. The committee agreed to undertake a request for the standardization of ¼-in. magnetic tape with 16mm perforations. Perforated tape o' this type is currently being used in new equipment both here and abroad. A subcommittee under the chairmanship of Harold Jones was formed to consider a standard for low-shrink film. This film is frequently referred to in American Standards relating to sound recording on film.

Dr. D. R. White, leader of the U.S. Delegation to the Harrogate ISO meeting, reported on items of interest to the committee (*Jour. SMPTE, 67:* 819–821, Dec. 1958). He said that the U.S.S.R. delegation had requested that consideration be given to a single-type perforation standard as agreed to by several nations at an international meeting in Budapest in 1936. The Harrogate meeting concluded with the recognition that the single-type perforation may ultimately replace the other types and a working group was formed to continue a study of the matter. The same group will also consider the incorporation of all types of 16mm film dimensions into one standard. The question of rounding off dimensions and the adoption of the metric system as the basic dimension was also discussed. The U.S. and the U.K. opposed the adoption of the resolution on the metric system. Dr. White concluded with a review of the ASA's position in connection with international standardization activity and stressed the importance of its participation to U.S. industry. He called for active participation and support of the ASA in their important work.

Screen Brightness

The committee reviewed the comments received on current standards proposals. Revised drafts will be submitted to the members incorporating many of the suggestions advanced at the meeting. Allen Stimson, chairman of a subcommittee on drive-in theaters, submitted a report on his committee's activity. The committee recommended that ideally there should be two prints of different density; one for indoor theaters and a lighter one for outdoor theaters. However, it was felt that it would be more desirable if a lighter print could be used for both indoor and outdoor theaters. A screen brightness proposal incorporating the recommendations of the subcommittee will be submitted to the committee for consideration as an American Standard. It was reported that a special template, designed to fit in the projector aperture to facilitate screen brightness measurements, was currently being evaluated. It was suggested that anyone interested in assisting with this evaluation should notify the staff engineer at Society Headquarters.

Television

An SMPTE Recommended Practice on 2 by 2 Slide Mounts is currently under consideration by the committee. A new subcommittee under the chairmanship of N. R. Olding, CBC, was assigned the study of TV cue-mark placement and the development of a new TV film leader. John Ballinger of Screen Gems, who has conducted extensive surveys on this subject, will assist Mr. Olding in this work. Subcommittee activity related to a Proposed American Standard on TV Projectors for Vidicon Camera Operation will continue under the chairmanship of H. N. Kozanowski. This committee will also consider a Recommended Practice for the cleaning of optical multiplexers. R. M. Morris is chairman of a subcommittee considering specifications for a Recommended Practice on Density Requirements for Monochrome Films for TV. It is anticipated that color film density requirements will be considered after satisfactory agreement has been reached on the black-and-white proposal. The chairman, T. G. Veal, asked Messrs. Olding and Wintringham to study existing CBC and Bell Telephone TV glossaries and to make a recommendation as to whether it was desirable to compile a single listing.

Film Projection Practice

In its consideration of the revision of American Standard Z22.4, Motion Picture Projection Reels, the committee decided to add specifications for a 3000-ft reel which is used primarily by the TV broadcasters. It was reported that the new MPRC-SMPTE All-Purpose Projector Alignment Test Film (APAL) would be available in the near future. This film consists of a basic target which incorporates all standard aperture sizes including the 0.715-in. by 0.839-in. aperture. It may also be used for testing height steadiness, side weave, travel ghost, focus and breathing and buckling.* The staff engineer circulated a brief ISO report on items of interest to the members of the committee. Reference was made to the U.S.S.R. request that a single-film perforation and sprocket be adopted in order to facilitate international exchange of motion-picture release prints and television-film programs. The committee will await further action by the Interim ISO Working Group before placing it on its program of work.

Sound

Vice-Chairman E. W. D'Arcy reported that developments at the recent international meeting indicated that sufficient information was now available in order to standardize on the SMPTE Magnetic Multifrequency Test Film in terms of absolute magnetic level. Mr. D'Arcy will draft a standards proposal for the committee's approval in the near future. M. G. Townsley, U.S.A. Delegate to the ISO/TC 36 meeting, submitted a written report concerning the working group deliberations and resulting draft proposals on magnetic reproduce characteristics (*Jour. SMPTE, 67:* 822–823, Dec. 1958). Considerable time was devoted to a discussion of the pre-emphasis ISO-SMPTE Characteristic and the CCIR unmodified characteristic which has been adopted by the European countries. It was generally agreed that it was extremely difficult to eliminate hum, particularly in 16mm portable equipment, without using the low-frequency pre-emphasis. However, further discussion disclosed that the prescribed amount of pre-emphasis could cause distortion in 35mm equipment. A test film incorporating the CCIR characteristic is being evaluated by the committee. The committee will withhold further action pending consideration of the final report.

The committee has been considering an extension of frequency of the Society's Magnetic Multifrequency Test Film. The final evaluation of a test reel circulated for comment indicated that the extension would be practical and advisable. Consequently, the committee voted in favor of extending the present M16MF Test Film to 10 kc. A Proposed American Standard for a Multi-Azimuth Test Film is presently under study. The specifications were prepared by a subcommittee chaired by J. L. Pettus. A test film produced in accordance with this standard would permit the determination of azimuth alignment without disturbing head adjustment. A subcommittee under the chairmanship of G. R. Crane will draft a standards proposal on Magnetic Track Width and Location of ¼-in. Magnetic Tape With 16mm Perforations. M. A. Kerr reported on and demonstrated the effect of his new approach to magnetic half striping of optical tracks. The committee was asked to consider a Recommended Practice on the proposed dimensions for Optical-Magnetic 16mm Sound. Mr. Kerr also requested that consideration be given to a Recommended Practice on 110-mil maximum/100-mil minimum playback heads. The committee will take the request under advisement pending display of sufficient active interest to warrant the practice.

16mm & 8mm

The committee reviewed the status of current projects. F. J. Kelly discussed his proposed method of measuring camera steadiness by means of a visual oscilloscope presentation and requested the committee's advice on the method. After a brief discussion, it was decided that the existing methods of measurement, as proposed by Dr. A. C. Robertson and M. G. Townsley, should be circulated with Mr. Kelly's in order to arrive at a preferred method. The 16mm projector reel standard, PH22.11, is under committee review. Dr. A. C. Robertson will chair a subcommittee to draft a revised standard including specifications for a 600-ft and a 4000-ft reel. R. G. Herbst will chair a subcommittee to consider the revision of American Standard Z22.19, Location and Size of Picture Apertures of 8mm Motion-Picture Cameras.

* Further information on this APAL Film may be obtained from Society Headquarters.

High-Speed Photography

Chairman C. H. Elmer showed slides taken by Dr. H. E. Edgerton at the Fourth International Congress on High-Speed Photography which was held last year in Cologne, Germany. The SMPTE will sponsor the Fifth Congress which will be held in Washington, D. C., in 1960. The major portion of the meeting was devoted to a discussion of the plans for the Congress. L. L. Endelman, chairman of the High-Speed Papers Committee for the 85th Miami Convention, reported that there would be a greater percentage than usual of popular-type papers given which will be of interest to the layman as well as to the expert. G. E. Matthews noted that the committee was taking more of an interest in overall SMPTE activity, an attitude which he felt would benefit high-speed photography as well as the Society. The Chairman requested the committee's assistance in preparing the annual Progress Report. — *J. Howard Schumacher*, Staff Engineer.

news and reports

85th Convention—Miami

The theme of the 85th Convention, *Films and Television for International Communication*, will be dramatized by concurrent sessions on Television Facilities and Television Recording held in Miami and Havana and linked by two-way television. This particular plan is, of course, contingent upon the uneasy political situation becoming stabilized by Convention time, but it is only one of the important sessions and events which, even at this early date, are planned to make this occasion one of the most important and rewarding Conventions of recent times.

The Technical Sessions, the schedule for which has been tentatively set up, brings the interests of the Society into the main current of world affairs and indicates the wider areas to which its influence is extending.

SCHEDULE OF TECHNICAL SESSIONS (TENTATIVE)

Monday

Morning: High-Speed and Instrumentation Photography

Afternoon: Theaters and Projection (Concurrently) High-Speed and Instrumentation Photography

Evening: High-Speed and Instrumentation Photography

Tuesday

Morning: Laboratory Practice (Concurrently) High-Speed and Instrumentation Photography

Afternoon: Equipment Demonstrations and Papers

Evening: Cinematography

Wednesday

Morning: Audio-Visual Communications (Concurrently) Standards and Standardization

Afternoon: Committee Meetings

Thursday

Morning: Sound and Multilingual Films (Concurrently) Studio Lighting and Practices

Afternoon: Television Film Techniques

Friday

Morning: Television Facilities

Afternoon: Television Recording (possibly concurrent meetings in Havana and Miami on these topics with two-way television for a portion of the time)

It will be noted that the program is heavily weighted toward High-Speed Photography and Instrumentation, this being especially apt for the Convention locale. A tentative plan is to arrange a trip to Cape Canaveral for Saturday at the end of the Convention week, for a tour of the installations there.

Committee meetings will be held Wednesday afternoon. Thursday and Friday evenings are free, and on Thursday and Friday the afternoon sessions are scheduled to end at 3:30. This variation in the usual schedule is thoughtfully planned so that members and guests can take full advantage of sand and sun, as Florida members report that the late afternoon temperature is generally most conducive to healthful recreation at beach or swimming pool.

The Equipment Demonstration-Papers Session is expected to be a substantial one and will probably be given at least as much rapt attention by the audience as the more theoretical sessions. These will be descriptive demonstrations by Convention Exhibitors.

It is unusual and most gratifying that, at this stage of program planning, so much has been accomplished and so much form and unity are evident in the tentative schedule. The outlook for papers seems to be for a consistently high level of presentation with advance indications for a few of unusual significance.—*Garland C. Misener*, Program Chairman.

International Equipment Exhibit

Brochures and order forms inviting participation in the Exhibit went out a few days ago. Even before they were mailed, expressions of interest had been received from almost 50 companies, including several in England, France, Germany and Japan, indicating that this will be beyond any doubt the largest and most widely representative show that the Society has ever sponsored.

Probably because of the location and the prevalence of nearby missile bases, the number of manufacturers of photographic instrumentation equipment is particularly striking. Others already expressing their desire to participate include companies producing cameras, motion-picture film, projectors and screens, closed-circuit TV equipment, magnetic/optical sound devices, editing-room equipment, processing machines and laboratory instruments of all kinds, and TV and motion-picture studio lighting.

Space presently contracted for at the Fontainebleau will accommodate 47 booths only. Since additional space will evidently need to be provided to meet the demand that is already accumulating, all those who plan to be represented at this show should lose no time in getting their order to the Exhibit Committee Chairman, John B. Olsson, so that he will be able to estimate total requirements early enough to arrange with the hotel for the extra space that will be required. John's address is c/o Beattie-Coleman, Inc., 1000 N. Olive St., Anaheim, Calif.

Education, Industry News

The National Defense Education Act of 1958 (Public Law 85-864) makes specific provision for the purchase of audio-visual materials to be used in educational programs in public schools throughout the nation. Title VII of the Act recognizes the new trend in education by providing for research leading to more effective utilization of television, radio, motion pictures and other audio-visual aids for educational purposes.

An analysis of the provisions of the new law which affect the audio-visual field is contained in an informative booklet, *AV-864*, prepared by the National Audio-Visual Assn., Fairfax, Va. Tables are included showing allocations to each State under the $40 million initial appropriation. Also included are lists of audio-visual materials and equipment which might be purchased for educational purposes under the provisions of the Act. Interpretations of the new legislation (also known as the Hill-Elliott Law) have been checked with officials of the U.S. Office of Education, including those who will administer it. The 13-page booklet is available from the Association without charge.

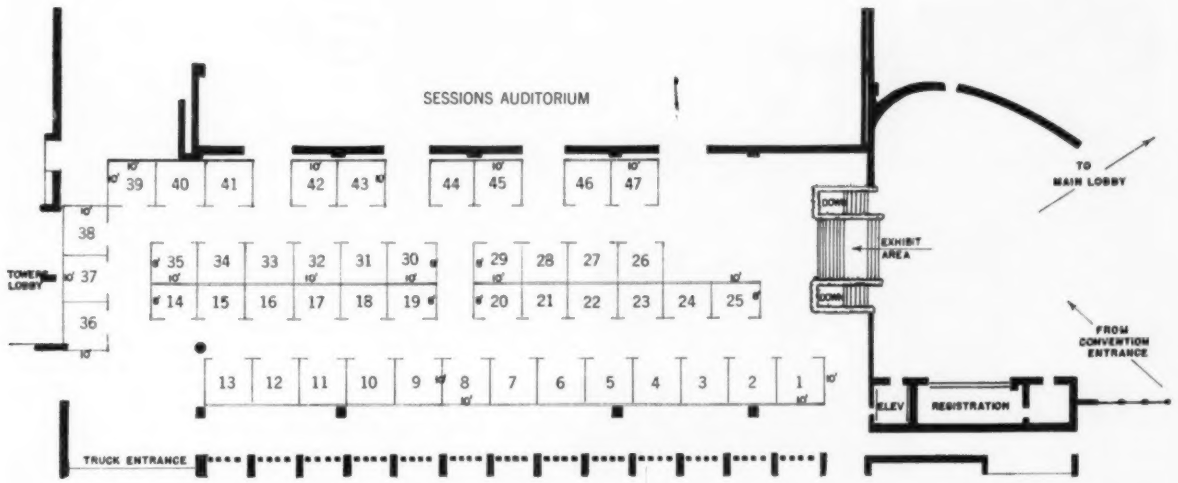
A survey of radio and television courses in 25 universities shows wide variations in the pattern of instruction, suggesting that "the men responsible for instruction in radio and television have come to no final collective decision as to either the purposes and objectives of instruction on the one hand, or the types of courses which should be offered to provide a well-rounded pro-

International EQUIPMENT EXHIBIT

. . . for the FIRST time in the U.S.—professional motion-picture and TV equipment from all over the world

No one connected with our industry should miss this great display of quality equipment from the world's leading manufacturers. See the very latest developments in . . .

- ★ high-speed and instrumentation photography
- ★ closed-circuit TV equipment
- ★ motion-picture processing and lab equipment
- ★ magnetic/optical sound devices
- ★ editing-room equipment
- ★ studio and projection lighting
- ★ cameras
- ★ projection equipment



BOOTH RENTAL RATES: Booths 1–13, 36–47. . . . . .$300 Booths 25–35. . . . . .$275

RESERVATIONS for booth space are now being made by the Exhibit Committee Chairman:
John B. Olsson, c/o Beattie-Coleman, Inc., 1000 N. Olive St., Anaheim, California

85th SMPTE Semiannual Convention / EXHIBIT OPEN MAY 4 thru 7 Fontainebleau Hotel, Miami Beach

gram of undergraduate instruction, on the other."

Results of the survey are presented by Harrison B. Summers in an article, "Instruction in Radio and Television in Twenty-Five Selected Universities," in the Fall 1958 *Journal of Broadcasting*, published at the University of Southern California. Dr. Summers, a pioneer in the field, initiated more than 25 years ago the first course in broadcasting offered by Kansas State College. He is presently in charge of radio and television instruction in the Department of Speech at Ohio State University. The information contained in the article was assembled from university bulletins and answers to questionnaires.

The 25 universities were selected as representative of schools offering broadcasting courses. Factors influencing the selection included geographical distribution and type of departmental organization. Eleven of the schools surveyed had independent departments for radio-TV instruction and 14 offered certain courses in departments such as Speech, Drama or Journalism.

Four tables show (I) quarter hours of credit available to undergraduates in 11 major categories; (II) specific radio and TV courses offered in each of the 25 universities; (III) courses required of radio-TV majors; and (IV) estimate of percentages of the major students who will be engaged in each of nine types of activity five years after graduation.

Apparently three types of students take these courses: those who take a few courses as part of preparation for a professional career such as law, politics or public relations; those who do major work but who choose other fields after graduation; and those who make a life work of television or radio.

Among the courses of special interest listed in Table II are Control and Equipment Operation, offered by six universities with the University of Houston and Wayne University in the lead (13.5 and 12 quarter hours of credit, respectively); Operations and Procedures, with Houston Univ. leading with 4.5 quarter hours of credit; Production of Films for TV, with Houston and Indiana Univ. leading; and TV Art, Design and Lighting, with New York Univ. in the lead. A total of 47 courses is offered by the 25 universities. Only such courses as are part of the regular college curriculum and are open to undergraduates were considered.

In an article on "Television Production Training," by Jack Warfield, in the Fall 1958 *Journal of Broadcasting*, published at the University of Southern California, the author takes the position that TV instruction in colleges and universities suffers from the "liberal arts approach" which results in laboratory training being reduced to an "irreducible minimum." He attributes this to efforts of administrators to avoid the stigma of being overly "vocational." Dr. Warfield is Assistant Professor in the Dept. of Telecommunication, Univ. of Southern Calif., and Coordinator of KUSC-TV, the student-operated, closed-circuit station. He suggests in the article that courses in television production should be subject to review: "If the so-called trade schools, the armed services, or industrial plants are able to achieve better results than the liberal arts college or univerisity, it might be conceivable that these specialized agencies have discovered something in instructional techniques that would be worth investigating."

The report on a survey of technical institute education in the United States conducted by the American Society for Engineering Education, Urbana, Ill., will be published early in 1959 and is expected to contain a strong recommendation for increased support for technical institutes offering two-year programs. In 1956, a total of 121 institutions offering technical institute curricula reported 11,091 graduates and an enrollment of 49,968.

Translation into English from the *Czechoslovak Journal of Physics* has been announced by the Consultant Bureau Inc., 227 W. 17 St., New York 11. Beginning with the January 1959 issue all non-English articles will be translated and issued at an annual subscription rate of $50.00 for 6 issues. Widely regarded as an important publication in the field, the Czechoslovak Journal contains articles in Russian, German, English and French. The translating will be done by physicists who have command of one or more languages other than English. All tabular, diagrammatic and photographic material integral with the text will be included in the translation.

AMPEX

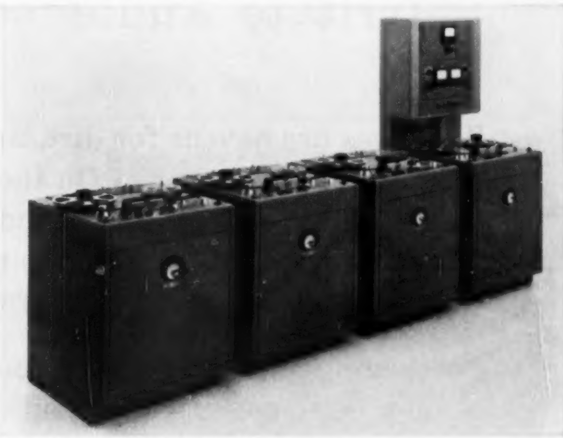
World Leader in Precision Magnetic Tape Recording Instruments

Ampex Tape Recorders are in service throughout the world in television and radio stations, and in professional sound recording studios... wherever finest quality is required.

VR-1000 *Videotape* Recorder*
First commercially available Videotape Recorder. Magnetically records what the TV camera "sees," in either black and white or color. Playbacks look "live."

MODEL 300 *Magnetic Tape Recorder*
Standard of the professional recording industry, it consistently delivers the finest in audio reproduction. Available in as many as 8 channels, in console and rack mounting.

MODEL 351 *Magnetic Tape Recorder*
First choice of the broadcasting industry. Features printed circuits and miniature tubes. Available in console, rack and portable models, with one or two channels. Sold by dealers.



MODEL 3200 *Magnetic Tape Duplicator*
High speed duplication, with superb fidelity, of recorded master tapes. Makes up to 10 copies at one time. Available with one, two or four channel heads.

Fully illustrated brochures, complete with specifications, are available on each recorder and the duplicator. Technical bulletins are also available on the following subjects: VIDEOTAPE RECORDING • VIDEOTAPE SPLICING • MULTI-CHANNEL RECORDING • MULTI-CHANNEL TECHNIQUES • Write for the copies you want, today.

Tenth Year of Leadership

934 CHARTER STREET, REDWOOD CITY, CALIFORNIA

AMPEX CORPORATION

professional products division

*TM Ampex Corporation

Eighteen to twenty Fellowships will be awarded to qualified applicants by the Daniel and Florence Guggenheim Foundation, 120 Broadway, New York 5, for advanced professional training in rocket and jet propulsion engineering and in flight structures. The Fellowships are awarded each Spring for study commencing the following Fall. Applicants for Jet Propulsion Fellowships should apply directly to either Princeton University or to California Institute of Technology. Applications for Fellowships in Flight Structures should be made directly to Columbia University.

The 1959 IRE National Convention will be held March 23–26 at the Waldorf-Astoria Hotel and the Coliseum, New York. More than 55,000 engineers and scientists from 40 countries are expected to attend. A program of approximately 275 papers will be presented in 54 sessions. A symposium on "Future Developments in Space" will be held Tuesday evening, March 24. The Radio Engineering Show held in conjunction with the Convention will occupy all four floors of the Coliseum.

The rank of Fellow in the Institute of Radio Engineers has been bestowed posthumously upon Pierre M. G. Toulon (*Journal*, p. 701, Oct. 1958) in recognition of his contribution to the control of gaseous conducting devices and in the field of color television. The grade of Fellow is the highest membership grade of the IRE, honoring those who have made outstanding contributions to radio engineering or allied fields. A total of 76 leading scientists and engineers were recently made Fellows of the IRE, effective January 1. SMPTE members so honored include Victor A. Babits, Prof. of Electrical Engineering, Rensselaer Polytechnic Inst., Troy, N. Y., for contributions to engineering education and pioneering in television; J. M Barstow, Bell Telephone Labs., Murray Hill, N. J., for contributions to the transmission of monochrome and color television; and E. H. Hansen, Consulting Engineer, Balboa Island, Calif., for contributions to the development of motion-picture sound recording and reproduction.

Lee J. Heagerty has resigned as Vice-President of Merchandising for Grant Advertising Inc., of Canada, to accept the post of President of Hudson Productions Ltd., Montreal, international lip-synchronization service for films. The firm has launched an expansion program and plans are underway to open overseas offices and facilities in Havana, Madrid, Lisbon and West Berlin. Under the new program the company will produce lip-synchronous soundtracks for TV films and motion pictures in French, Spanish, Portuguese and German.

John R. Howland has been appointed Sales Manager, Closed-Circuit TV and Product Control Equipment, Government and Industrial Div., Philco Corp., Philadelphia. For the past three years Mr. Howland has been General Sales Manager of the Dage Television Div., Thompson Products Co. During this time he was responsible for developing closed-circuit systems in about 50 schools and colleges and in many hospitals and industrial plants. He also installed a closed-circuit system in the Pennsylvania Railroad Station, New York. He has been active in the field of television since 1935 when he first joined Philco, then known as the Philadelphia Storage Battery Co. During World War II he served in the U.S. Army Signal Corps. He attained the rank of Colonel and served as Executive to the Chief Signal Officer, European Theater of Operations and as Signal Officer, United Kingdom Base.

Lloyd A. D. Colvin, a specialist in the field of development and experimentation with high-speed photography, has joined the staff of Gordon Enterprises, North Hollywood, Calif. He was formerly a Warrant Officer in the Navy. During World War II he was in charge of a project involving a photographic record of the performance of a then newly developed aircraft rocket. He received a special Navy commendation for this work.

Paul N. Robins has been elected President of Permafilm Inc., 723 Seventh Ave., New York 19, to succeed the late Pierre Clavel. Mr. Robins is also President of Library Films Inc. and Television International Co., He was formerly Vice-President of United Factors Corp. and of Manufacturers Trust Co.

Edward Victor Lewis has been appointed Engineering Manager for Beattie-Coleman Inc., 1000 N. Olive, Anaheim, Calif. Until recently he was a project engineer for Houston Fearless Corp. and has had more than 20 years of merchandising experience.

current literature

The Editors present for convenient reference a list of articles dealing with subjects cognate to motion-picture engineering published in a number of selected journals. Photostatic or microfilm copies of articles in magazines that are available may be obtained from The Library of Congress, Washington, D.C., or from the New York Public Library, New York, N.Y., at prevailing rates.

American Cinematographer vol. 39, Oct. 1958
Animated Film Techniques. Pt. IV. (p. 626) *C. Fallberg*
Sound Tracks for 16mm Animated Films (p. 629) *S. W. Jones*
Lens-Coupled Exposure Meters—Next for Professional Cameras? (p. 630) *E. Wildi*

Bild und Ton vol. 11, Oct. 1958
Die elektronische Filmaufnahme (p. 255) *E. Kroschke* und *W. Günther*
Eine neue Filmentwicklungsmaschine (p. 261) *K. Speilhagen*

British Kinematography vol. 33, Sept. 1958
A Single System 16mm Camera with Magnetic Recording (p. 63) *L. H. Bacon*
Pre-striped 16mm Film (p. 71) *R. J. T. Brown*
vol. 33, Oct. 1958
Some Problems in Television Lighting (p. 91) *W. C. Pafford*
A Revolutionary Light Source and a Modern Projector (p. 99) *R. H. Cricks*
Apparatus for Measuring Image Unsteadiness in Motion Picture Cameras (p. 102) *L. J. Wheeler*

International Projectionist vol. 33, Oct. 1958
Image Contrast and Picture Quality (p. 5) *R. A. Mitchell*
The Geneva Intermittent Movement: Its Construction and Action (p. 8) *A. C. Schroeder*
Movies of the Future: Projection at the Brussels World's Fair (p. 11) *A. Mosby*
vol. 33, Nov. 1958
Are Lenticulated Screens Practical? (p. 5) *R. A. Mitchell*
Radically New Light Source Spurs New Projector Design (p. 8) *R. H. Cricks*

Kino-Technik vol. 12, Oct. 1958
Europas Beitrag zur Kinotechnik
Deutschland: Moderne Technik in der Filmherstellung (p. 272) *E. Leistner*
Wesentliche Verbesserungen in der Wiedergabetechnik (p. 278) *G. Haufler*
England: Aufnahme und Wiedergabe technisch vollendet (p. 280) *R. H. Cricks*
Frankreich: Filmkunst und Filmindustrie mit hohem Niveau (p. 282)
Italien: Technisch hochentwickelte Wiedergabegeräte (p. 285)
Niederlande: Weltweite Verbreitung der Philips-Geräte (p. 286) *W. J. M. Jansen*
Schweiz: Kinogerätebau mit Schweizer Präzision (p. 289)
vol. 12, Nov. 1958
Neues Musikaufnahme-Atelier bei der Ufa in Berlin (p. 338)
Moderne Tontechnik bei der Mosaik-Film GmbH (p. 340)
Europa-Tonstudio in der Filmstadt Prag-Barrandov (p. 345) *E. Lieb*
Studio- und Theatertechnik auf der "Photokina" (p. 350)

Proc. IEE 105, Pt. B, Nov. 1958
A New Cathode-Ray Tube for Monochrome and Colour Television (p. 581) *D. Gabor*

Proc. IRE vol. 46, Nov. 1958
Electronic Composites in Modern Television (p. 1798) *R. C. Kennedy* and *F. J. Gaskins*

Review of Scientific Instruments
vol. 29, Nov. 1958
High-Speed Multiple-Spark Light Source (p. 949) *M. R. Wilson* and *R. J. Hiemenz*

section reports

The Atlanta Section meeting of May 21 held at the Architecture Auditorium, Georgia Institute of Technology, Atlanta, was the best attended of the spring. Fifty-six were present for the program which was devoted entirely to color. W. T. Hanson, Jr., Eastman Kodak Co., used dual projectors for a comparison of Commercial Kodachrome and Ektachrome Commercial. Original material, dupes, and negative/positive duplicates of each original were shown. The views of a service laboratory as regards the various color duplicating processes available were presented by W. D. Hedden, The Calvin Co. A sample reel presented at the Calvin Workshop in March was projected. Winding up the program, William H. Metzger, Ansco, presented a fine roll of scenes made in color on Super Anscochrome under existing light conditions, followed by a paper in nontechnical terms, easily understood by all present.—*Edward E. Burris*, Secretary-Treasurer, Motion Picture Unit, Lockheed Aircraft, Marietta, Ga.

The Canadian Section reached a milestone in its growth with its May 24th meeting at Queen's University, Kingston, Ont., when approximately 60 members from Toronto, Ottawa, Montreal and other Canadian points met for a one day color conference. Several members from the Rochester Section were also in attendance. The afternoon was planned to provide something of interest and value for all the members, no matter what segment of the motion picture and TV industry they represented.

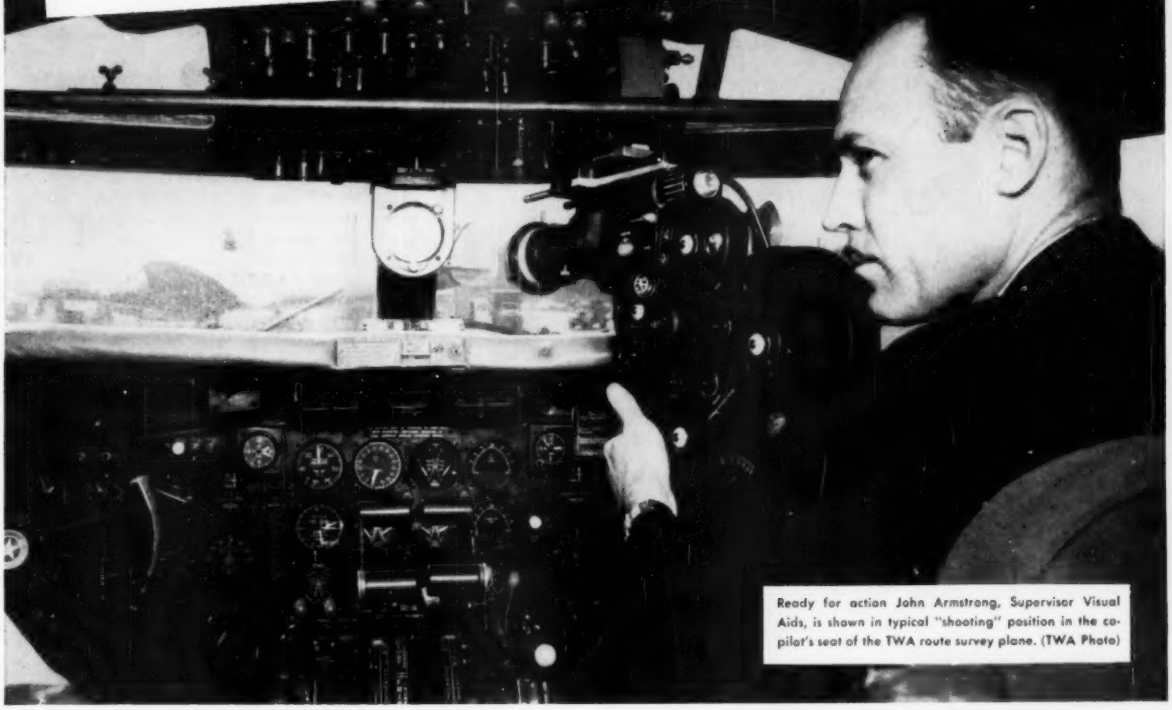
Ralph Evans, Eastman Kodak Co., Rochester, spoke on "Seeing Light in Color," discussing the subject from a psycho-physical viewpoint. Among other things, Mr. Evans pointed out that identical colors or hues seen under one condition could be completely different when seen under other conditions. For those mainly interested in color film, the organizing committee selected Lloyd C. Thompson of The Calvin Company, Kansas City, Mo., who spoke on the subject of "Pros and Cons of 16mm Color Film Techniques." Some of the problems leading up to what the company considers the "ideal" way to deliver a finished product, originally shot on Eastman Commercial Kodachrome, to the client were discussed by Mr. Thompson.

ARRIFLEX SERVES TWA
TRANS WORLD AIRLINES

writes MR. J. G. ARMSTRONG, SUPERVISOR VISUAL AIDS,
Flight Training Center, Trans World Airlines, Kansas City, Mo:

"...I have used the Arriflex before, and found it to be exactly what I needed to produce the movies which we use in training our pilots. Our pictures are taken with the Arriflex mounted so as to shoot out of the first officer's forward windshield panel. Due to the fact that a Connie cockpit has practically no room overhead, the Arriflex is mounted upside down and is operated running in reverse. A Film-orama anamorphic lens is mounted ahead of an Arriflex 28mm lens.

We have found that the Arriflex's registration pin eliminates any difficulties which might result from the gravity sensitivity of the camera's moving elements in flight. This is important since the camera is subject to varying forces in flight, especially at the low levels we use for photographing instrument approaches to airports..."



Ready for action John Armstrong, Supervisor Visual Aids, is shown in typical "shooting" position in the co-pilot's seat of the TWA route survey plane. (TWA Photo)

Only the Arriflex 16 has the features which make this camera so valuable to TWA: Light weight and compact, 400 ft. magazines, registration pin film transport, reverse filming, electric motor drive and last but not least, mirror-reflex shutter (not a beam splitter) for through-the-lens focusing and viewing.

The Arriflex can serve you better, too! Fill out and mail coupon for detailed information.

SOLE U. S. DISTRIBUTOR

KLING PHOTO CORP.
257 Fourth Avenue, New York 10, N. Y. 7303 Melrose Avenue, Los Angeles 46, Cal.

To: KLING PHOTO CORP.
257 Fourth Ave., New York 10, N. Y.

I would like free literature:

Arriflex 16 ☐ Arriflex 35 ☐ Lease Plan ☐

Demonstration without obligation, of course. ☐

Name________ Title________

Company________

Address________

City________ Zone____ State____

Following this discussion, a demonstration print showing six different end products was shown. These were, in order of their appearance, a Kodak 5269 color print from original Kodachrome, a Kodak 5269 print from a color dupe, an Eastman color positive print from Eastman internegative material, a reversal black-and-white print from the original, a standard theatrical quality release print from a duplicate negative made from the color original and a television quality print from the same dupe negative.

For the television people, John W. Wentworth of the Radio Corp. of America spoke on "Color Television." Mr. Wentworth spoke "electronically" as he described the operations of the present day compatible color television system.

After the meeting, many of the members and their wives attended a "Dutch Treat" cocktail party in the Burgundy Room of the Hotel LaSalle and a dinner and dance which closed the day's events, which many acclaimed the most memorable in the history of the Canadian Section.—*R. E. Ringler*, Secretary-Treasurer, c/o DuPont Co. of Canada, Ltd., Toronto, Ont.

The Chicago Section's meeting of May 16 constituted another highly successful regional affair, attracting over 200 members and guests from Detroit, St. Paul, Kansas City and Colorado Springs, as well as the local Chicago area. Afternoon and evening sessions were held at the Furniture Club of America, Furniture Mart, Chicago.

The program opened with Richard O. Painter, Asst. Dept. Head, Experimental Engineering, General Motors Corp., speaking on high-speed photography applied to automotive research engineering. A description of an automatic shutter for motion-picture printing machines was given by Theodore W. Batterman, Electronic Systems, Inc. Then Robert W. Wagner, Director of Motion Picture Production, Ohio State Univ., reported on the status of 16mm film production in universities and colleges. Following this, a direct-drive automatic iris control was described by Mervin W. La Rue, Jr., Bell & Howell Co., Chicago. Next, a team from Eastman Kodak Co., N. H. Groet and Herbert L. Rees, described an improved professional 16mm reversal color camera film and its processing. Documentary film techniques of the U.S. Air Force were outlined by Capt. Robert Sonnett, Chicago, and color films illustrating the Air Force guided missile launching and precision jet flying teams were shown. Lloyd Thompson of The Calvin Co., Kansas City, Mo., capped the day with a fascinating wide-screen color slide showing and personal narrative describing his trip through Russia.

The afternoon session was followed by a cocktail party for the dinner guests, hosted by the film industries in the Chicago area. As an innovation the evening program was planned with the members' wives in mind and the women turned out forty strong for the latter session. Special thanks were in order for Dick Hertel of Kling Studios, Program Chairman, for making all the program arrangements and converting the meeting room into a theatre by amassing the 3 16mm projectors, 35mm arc projector, 3¼ × 4¼, 2 × 2 and wide-screen slide projectors and CinemaScope screen necessary for the presentations.—*William H. Smith*, Secretary-Treasurer, Lakeside Lab, Box 2408, Gary 5, Ind.

The Chicago Section rounded out the first half of its activities for the year with a meeting on June 16 in Room 211 of the Prudential Plaza Building. Two papers presented by Chicago area members drew an attendance of 57 members and guests.

A joint discussion of film cleaning and handling by Richard Wallace and Howard Bowen of the Harwald Co. began the program. Included was a brief review of past techniques as well as a description of present and proposed methods. Noting the importance of efficient cleaning procedures to the industry, Mr. Wallace emphasized the growing need for multiple purpose materials which will protect and lubricate as well as clean films of all types. Color slides illustrated details of equipment designed to use such multiple purpose cleaners taking into account the cleaning action required, evaporation rate, toxicity, odor and other considerations.

The other paper, concerned with automatic mixing of soundtracks, was delivered by G. W. Kugel and Jack Sweeney of Dallas Jones Productions. Problems confronting the sound engineer in properly mixing a track were discussed after which a

demonstration was made of an experimental mixer control designed to overcome some of these problems. In this equipment, multiple tapes are used and are cued in much the same way that motion-picture films are cued for release printing. A console panel consisting of selector switches can then be preset to provide automatic fading and dissolving. This control enables the sound engineer to concentrate on the primary problem of accurate sound-level control necessary for a good mix. A lively question and answer session followed these papers after which the meeting adjourned to a coffee and coke session.—*William H. Smith*, Secretary-Treasurer, Lakeside Lab, Box 2408, Gary 5, Ind.

The Dallas-Ft. Worth Section offered a tour of the new studio and laboratory facilities at the Jamieson Film Co. as its July 11 meeting. Approximately 75 members and guests accepted the invitation and were present to hear architect W. E. Benson discuss some of the problems encountered in studio design and construction. Following this, Hugh Jamieson described the sound recording facilities and Bruce Jamieson gave an interesting paper on an extremely low-volume tube-type continuous processing machine made entirely of plastic. The machine was developed by the Jamieson Film Co. In its operation, each strand of film is completely surrounded by a small oval-shaped polystyrene tube filled with processing solution. The movement of the film through the tube pumps the solution through the machine. The design is of particular interest to color processing since the volume of costly solutions required is extremely small.—*E. J. Pattist*, Secretary-Treasurer, 3618 Marsh Lane Pl., Dallas.

The Hollywood Section held a meeting May 20 at the American Broadcasting Co. in Hollywood. Sidney P. Solow, Consolidated Film Industries, repeated the paper he had given at the 83rd Convention, entitled "Economic Aspects of Television Film Production in Color," for those who had been unable to attend. The results of a survey of a number of black-and-white and color half-hour films made for release to television were reported on. The average cost increases in color production over black-and-white were related to such factors as lighting, set decorating, costuming, raw film and processing. Cost comparisons on various methods of arriving at release prints were also discussed.

For the second half of the program, Robert W. Cochran, General Electric Co., read a paper by Messrs. Gula-Shephard and Wiggin of the Technical Products Dept. of General Electric, Syracuse, N.Y., which had been delivered at the recent NAB Convention. This was a well illustrated talk which showed some of the innovations in this 3-image orthicon color camera which features smaller size; improved optical system; ease of alignment, operation and maintenance; and greater stability during long periods of operation.—*Robert G. Hufford*, Secretary-Treasurer, Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The Hollywood Section meeting of June 17 was devoted to the use of color both in motion pictures and live television. The meeting was held at the National Broadcasting Company in Hollywood, approximately 170 being present.

Dr. Norwood L. Simmons, Eastman Kodak Co., presented a paper describing the use of false color-sensitized aerial color films for camouflage detection, and their peacetime civilian application for use in forestry work to distinguish between healthy green vegetation and that which has been cut or is diseased. Dr. Simmons' talk was illustrated by use of comparative slides in which the same subject matter was photographed on a conventional, properly color-sensitized aerial color film and on its false color-sensitized counterpart.

The use of color differentiation in the Chroma-Key process, as contrasted to the standard luminance matting used in black-and-white television, was discussed by Robert H. Pierce, NBC. This new process permits the foreground action to be placed in front of any background material desired, by simply performing the foreground action in front of a blue screen. The background action is supplied by a second color-television input which is keyed to feed the system whenever the primary camera, photographing the foreground action, is scanning the blue screen. This color matting process has been used extensively on the Dinah Shore program.—*Robert G. Hufford*, Secretary-Treasurer,

c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The New York Section held its May meeting on Wednesday, the 21st, attracting 195 members and guests to hear two papers on a new 16mm color reversal film. The meeting took place at the World Affairs Center Auditorium in the Carnegie Endowment International Center.

Forrest A. Richey read a paper entitled "An Improved Professional 16mm Reversal Film" which he co-authored with N. H. Groet and M. M. Liberman of the Kodak Research Laboratories, Rochester, N.Y. The paper described a new subtractive reversal color film which is designated as Ektachrome Commercial Film Type 7255 (16mm). This film is designed to provide high quality originals for the production of release prints. The film structure, sensitometric characteristics, exposure requirements, suggested filters and printing behavior of the film were covered.

Herbert L. Rees of the Color Technology Div. of Eastman Kodak Co. followed with a companion paper on "The Processing of an Improved Professional 16mm Reversal Color Camera Film" on which he collaborated with Deane S. Thomas, Jr., and Howard W. Vogt, also of Eastman Kodak Co. The paper covered the processing of Ektachrome Commercial Film Type 7255 in the process designated as ECO-1. Tank and replenisher formulas, important control factors, processing equipment and necessary precautions for successful processing were discussed.

It was reported that the Eastman Kodak Co. will process this film on the same facilities now used for Kodachrome Commercial Film Type 5268 which the new film is designed to replace. Ektachrome Commercial Film may also be processed by the user. The two papers were followed by a side-by-side demonstration of the new film and of Kodachrome Commercial Film, so that the audience had a chance to compare the quality of the new and the old. Coffee, coke and donuts were served through the courtesy of the Westrex Corp. in a social half-hour following the presentation of the two papers, a feature of the New York Section meetings that is becoming increasingly popular with the membership. A very interesting discussion of the papers with a question and answer session followed the social break. The Board of Managers and the Speakers met for dinner at Mannie Wolf's Chop House before the meeting.—*Robert M. Fraser*, Secretary-Treasurer, c/o Itek Corp., 700 Commonwealth Ave., Boston 15, Mass.

The Rochester Section devoted its June 12 meeting to hearing a general description of General Electric Company's Industrial Photographic Section. The attendance of 25 heard C. H. Ely, C. D. Gerber, W. F. Purtell and B. T. Holtman speak on the industrial photographic section of the General Electric Heavy Military Dept. Two films illustrating military progress reports were shown.—*R. E. Putman*, Secretary-Treasurer, 420 E. Corey Rd., Syracuse, N.Y.

The San Francisco Section met on May 13, with 35 members and guests present, at

the Cine-Chrome Laboratories, Palo Alto, to hear Burton Smith, Manager of the Laboratories, speak on Anscochrome films and their processing. Mr. Smith reviewed the processing done in the labs on the film for industrial and military projects, a great deal of which is classified work. A cameraman from Lockheed Aircraft Corp., Missiles Div., was present to show and demonstrate the Fastax Camera, in which Super Anscochrome is being used almost exclusively by Lockheed for high-speed photography in full color. Following the demonstration, a series of 16mm films were run, showing examples of various Eastman and Ansco color films, giving the members and guests the opportunity to make direct comparisons of the relative characteristics of the various color films now on the market.

After a brief duscussion period, during which a representative of Ansco was present to answer questions concerning his company's products, coffee and doughnuts were served by Mr. and Mrs. Smith. Preceding the meeting, many of the members met for cocktails and dinner at Hal's Restaurant in Palo Alto.—*Rodger L. Woodruff*, Secretary-Treasurer, KRON-TV, 929 Mission St., San Francisco.

The San Francisco Section had a first hand look at the Ampex Color Videotape Recorder at its June 10 meeting. Following cocktails and dinner at Ramor Oaks in Atherton, the Section, represented by an attendance of 80, met in the Demonstration Room at the Ampex Corp. in Redwood City to hear Project Leader of the Color VTR Group, Joseph Roizen, describe the company's new Color Videotape Recorder. First the obstacles to be overcome were outlined and the several different approaches that had been tried. The greatest problem is that of phase stability which must be some fifty times as great for color as that required for monochrome. The method currently being used at Ampex is to demodulate the reproduced color signal by use of a regenerated reference subcarrier which has essentially the same phase error as the reproduced chrominance signal. The I and Q signals thus obtained are then re-encoded to form a stable output signal. This method results in very acceptable reproduction provided that the tape is played back with the same head used in recording, and before any appreciable additional head wear has occurred. This limitation does not affect the machine's usefulness in the normal type of network time-zone delay operations. Following Mr. Roizen's talk and a brief discussion period, the members were shown some excellent color reproductions in a demonstration of the machine.—*Rodger L. Woodruff*, Secretary-Treasurer, KRON-TV, 929 Mission St., San Francisco.

Membership Certificates (Active and Associate members only). Attractive hand engrossed certificates, suitable for framing for display in offices or homes, may be obtained by writing to Society headquarters, at 55 West 42nd St., New York 36, Price: $2.50.

New Members

The next *Directory for Members* is planned for April 1960. The following members have been added to the Society's rolls since the list published in September 1958. Also listed are those regretfully reported as deceased since that date. The designations of grades are the same as those used in the *Directory*. An up-to-date list of the Sustaining Members appears on the outside back cover of each month's *Journal*.

Fellow (F) Active (M) Associate (A) Student (S)

Deceased

Werner George Alexewicz
John W. Butler
Leo A. Daniels
Edgar Gretener
Arthur J. Holm
Merriman H. Holtz
Raymond A. Lindsay
Don MacKenzie
Richard H. Newmayer
Harold A. Pendreigh
William Rathcke
Milton C. Scott, Jr.
Stephen Szeglin
Arnold Williams

Alexander, Henry D., Photo., U. S. Navy. Mail: 5217 Clemson St., Ventura, Calif. (A)
Alexander, Richard L., Univ. S. Calif. Mail: 15041 Palm Ave., La Puente, Calif. (S)
Armstrong, Donald G., Production Asst., Victor Kayfetz Productions. Mail: 64-29 Woodbine St., Brooklyn 27, N. Y. (A)
Auel, Carl J., Sound Eng., Valley Forge Films Inc. Mail: % Shelton College, Ringwood, N. J. (A)
Avril, Charles, Film Techn., Movielab Film Labs. Mail: 36 E. Skyline Dr., Waneque, N. J. (A)
Avrutis, Newton, Sound Recording Techn., IATSE. Mail: 160 W. 225 St., New York 63. (A)

Balzarini, Frank J., Projectionist, Elliot Unger & Elliot. Mail: 1618 71st St., Brooklyn 4, N. Y. (A)
Barber, Joseph L., Mot.-Pic. Lab. Techn., Pathe Labs. Mail: 955 Sherman Ave., New York 56. (A)
Bart, Jacques, Film Editor, Dynamic Films, Inc. Mail: 652 W. 163 St., New York 32. (A)
Battaly, Eugene D., TV Workshop. Mail: 136 Main St., Irvington, N. Y. (S)
Beech, Rolland V., Chief, Color Branch, Wright-Patterson A.F.B. Mail: 1863 Kipling Dr., Dayton 6, O. (M)
Bittle, Phillip V., Sr., Portrait Photo., Rembrandt Studios. Mail: 1325 Baugh Ave., East St. Louis, Ill. (A)
Blair, Robert F., Labcraft International Corp. Mail: 4019 Prospect Ave., Cleveland 3. (A)
Blair, Vachel L., Free-Lance Cameraman, 90 La Salle St. (9D), New York 27. (A)
Boehme, William F., TV Eng., 234 Stadium Bldg., University of Florida, Gainesville, Fla. (A)
Boesch, Eugene, Jr., Free-Lance Asst. Cameraman, 3147 Country Club Rd., New York 65. (A)
Braddock, John A., Free-Lance Asst. Cameraman, 56 W. 103 Pl., Chicago 28. (M)
Braum, Cyril M., Eng. Cons., Joint Council on Educ. TV. Mail: 1703 Black Oak La., Silver Spring, Md. (M)
Broecker, William L., Mich. State Univ. Mail: 231 Louis St., East Lansing, Mich. (S)
Bruck, Andrew F., Radio Eng., Miami Univ. Mail: 201 Walnut St., Hamilton, O. (M)
Bryant, David L., Photo., Western Electric Co. Mail: 1253 Elmdale Ave., Chicago 40. (A)
Bugg, Graham C., Univ. Calif. L.A. Mail: 1705 S. Purdue Ave., Los Angeles 25. (S)
Burchard, Gerard W., Teacher of Photo., L.A. Board of Educ. Mail: Box 8792, Crenshaw Station, Los Angeles 8. (A)

Calamai, Edward A., Mech. Eng., General Precision Lab. Mail: 179 Warren Ave., Hawthorne, N. Y. (A)
Caldwell, John T., Jr., Mich. State Univ. Mail: 2604 Blake St., Lansing 12, Mich. (S)
Capel, George E., Science Asst., Queens College. Mail: 107-11 Van Wyck Expressway, Jamaica 35, N. Y. (A)
Carothers, Robert E., Instrumentation Photo., Boeing Airplane Co. Mail: 1516 37th Ave., Seattle 22, Wash. (A)
Carroll, Joseph, Film Techn., Movielab Film Labs. Mail: 297 Greve Dr., New Milford, N. J. (A)
Chamberlain, David D., Brooks Inst. Photo. Mail: 4806-B Third St., Carpinturia, Calif. (S)
Chandler, Andrew A., Optical Cameraman, R. H. Ray Film Ind. Mail: 1949 Dorothea Ave., St. Paul 16, Minn. (M)
Cohen, Paul, Production Mgr., Owen Murphy Productions. Mail: 2432 Kayron La., North Bellmore, N. Y. (A)
Coleman, Alfred S., Jr., Mot.-Pic. Developer, U.S. Army Pict. Center. Mail: 167-30 109th Ave., Jamaica 33, N. Y. (A)
Conner, Richard W., Section Chief, TV Design, Hallamore Electronics Co. Mail: 3540 N. Shipway, Long Beach, Calif. (M)
Coolidge, Phil E., Free-Lance Prod., Cameraman, 3 Blanchard Rd., Cambridge 38, Mass. (M)
Cooper, Melvyn J., Univ. So. Calif. Mail: 9402 Beverlywood, Los Angeles 34. (S)
Cooper, Percy I., Univ. So. Calif. Mail: 3337 City Terrace Dr., Los Angeles 63. (S)
Cory, Gordon C., Techn., Tech.-Info. Photo. Div., U.S.N.A.M.T.C. Mail: 3016 Sereno Ave., Ventura, Calif. (A)
Cox, Frank H. W., Independent Industrial Film Prod., Chestnut Cottage, Higham La., Tonbridge, Kent, Eng. (A)
Crosby, Arthur F., Data Analyst, Coleman Engineering Co. Mail: 349 N. 300 W., St. George, Utah. (A)

Davis, Robert B., Owner, Film Library & Audio Visual Equip., 416 A Broad St., Nashville, Tenn. (M)
Davis, Seth C., Jr., Sales, Ansco. Mail: 832 S. Ballas Rd., Kirkwood 22, Mo. (A)
Dibeler, Edward N., Univ. Miami. Mail: Box 8877, University Branch, Coral Gables 46, Fla. (S)
DiMarzio, Edward S., Film Editor, Manhattan Prod. Mail: 2317 Lyon Ave., New York 62. (A)
Di Pasquale, Joseph, Free-Lance Asst. Cameraman, 1356 70th St., Brooklyn 28, N. Y. (M)
Dishler, Jules J., Design & Devel. Eng., Radio Corp. of America. Mail: 312 Cranford Rd., Woodcrest, Haddonfield, N. J. (A)
Donaldson, James N., Photo. Optical Equip. Techn., U.S. Navy. Mail: Town Creek Manor, California, Md. (A)
Dorsey, George M., Special Repr., Warner Bros. Pictures. Mail: 1359 Kalmia Rd., N. W., Washington 12, D. C. (M)

Egan, John F., Supervising Design Eng., Eastman Kodak Co. Mail: 56 Wimbledon Rd., Rochester 17, N. Y. (M)
Elder, Robert P., Mot.-Pic. Projectionist, KAKE-TV. Mail: 2717 Litchfield, Wichita 4, Kan. (A)
Elsner, Millard, Mich. State Univ. Mail: 145 Milford, East Lansing, Mich. (S)
Esquivel, Humberto G., Asst. Production Mgr., Dillon-Cousin de Mexico. Mail: Vallarta 21—5, Mexico, D.F., Mex. (M)
Estes, David N., Univ. So. Calif. Mail: 2105 W. 57 St., Los Angeles 62. (S)

Famoso, Alfonso, Film Techn., Movielab Films, Inc. Mail: 348 E. 28 St., Brooklyn, N. Y. (A)
Finkel, Marc E., Mot.-Pic. Writer-Prod., 224 Stadium Bldg., University of Florida, Gainesville, Fla. (A)
Fitzgerald, Leonard J., TV Techn., Canadian Broadcasting Corp. Mail: 120 Mumbercrest Blvd., Toronto, Ont., Can. (A)
Flaherty, George J., Projectionist, IATSE, 6636 Hollywood Blvd., Los Angeles. (M)
Fleming, Malcolm L., Indiana Univ. Mail: 1002 East 17 St., Bloomington, Ind. (S)
Flitters, Norman E., Entomologist, U.S. Dept. Agric. Mail: 9 Poinciana Ave., R. D. 2, Brownsville, Tex. (A)
Ford, Frederick W., Brooks Inst. Photo. Mail: Box 327, Ventura, Calif. (S)

Gannon, Daniel R., III, Univ. So. Calif., 922 W. 30 St., Los Angeles 7. (S)
Geib, Verling J., Free-Lance Projectionist & Sound Eng., 643 Main St., Deadwood, S. D. (A)
Gelenter, Robert H., Asst. to Producer, Martin Gelenter. Mail: 1750 Montgomery Ave., New York 53. (A)
Giannini, Louis L., Univ. So. Calif. Mail: 2555 W. 12 St., Los Angeles 6. (S)
Gillen, Charles R., Univ. So. Calif. Mail: 2667 Ellendale Pl., Los Angeles 7. (S)
Giroux, Daniel S., Mot.-Pic. Supvr., Argonne Natl. Lab. Mail: Box 299, Lemont, Ill. (A)
Glassoff, Stuart, TV Workshop. Mail: 1153 Boynton Ave., New York 72. (S)
Golden, George F., Mot.-Pic. Lab. Mgr., Escar Motion Picture Service. Mail: 1884 Roxford Rd., East Cleveland 12, O. (A)

Goldsmith, Merwin S., Univ. Calif. L.A. Mail: 559 Gayley, Los Angeles 24. (S)
Goodman, Harry E., Sales Mgr., Tech. Dir., Movie Supply Co., Inc. Mail: 9005 Mansfield Ave., Morton Grove Ill. (A)
Gorsky, Jack A., Mot.-Pic. Cameraman, U.S. Army. Mail: 1700 S. Wanamassa Dr., Wanamassa, N. J. (A)
Gottlieb, Jack O., Free-Lance Cinematog., 246 West End Ave., New York 23. (A)
Grant, Kenneth, Jr., Film Printer, Movielab Film Labs. Mail: 155 Fycke La., Teaneck, N. J. (A)
Green, Harold, Manager, Park Photo Supply Co., 77 Craig St., W., Montreal, Que., Can. (M)
Greene, Nat, City Col. N. Y. Mail: 1869 Walton Ave., New York 53. (S)
Gregg, D. P., Electronic Eng., Westrex Corporation, 6601 Romaine St., Hollywood 38. (M)
Gunnette, Thomas R., Training Aids Specialist, General Electric Co. Mail: 427 S. Main, North Syracuse, N. Y. (M)

Hajnal, Stephen, Mot.-Pic. Cameraman, Lew Pollack Products. Mail: 2601 Henry Hudson Pkwy., New York 63. (M)
Hall, Frederick W., Univ. So. Calif. Mail: 26824 Indian Peak Rd., Rolling Hills, Calif. (S)
Hall, Roger W., Owner, Midmar Prods., 2620 Taylor Ave., College Park, North Las Vegas, Nev. (A)
Hames, George W., Film Director, Canadian Broadcasting Corp., 70 Bell Rd., Halifax, N. S., Can. (M)
Hanellin, Richard M., Mot.-Pic., TV Cameraman, Cine Speed Inc. Mail: 112 S. Hewlett Ave., Merrick, N. Y. (M)
Harper, Leonard I., Foreman-Techn., MacDonald Tobacco, Inc. Mail: 162 Laval Ave., Laval DesRapides, Montreal, Que., Can. (A)
Harris, Denny C., Free-Lance Photo., 118 St. Clair, N. E., Cleveland 14. (A)
Heck, Edward R., Univ. So. Calif. Mail: 739½ W. Imperial Hwy., Los Angeles 44. (S)
Heinze, Herman D., Cinematog., WTIC-TV, 17 Central Row, Hartford, Conn. (A)
Heman, Robert H., Jr., Mot.-Pic. Sound Techn., Samuel Goldwyn Studios. Mail: 5738 Katherine Ave., Van Nuys, Calif. (A)
Herrick, Merlyn C., Indiana Univ. Mail: 130 Ridgeview Dr., Bloomington, Ind. (S)
Hickey, 1/Lt. Thomas B., 079325, Photo., 69th Signal Corp. Mail: APO 227, New York, N. Y. (A)
Hicks, Walter R., Pres., Reevesound Company, Inc., 35-54 36th St., Long Island City 6, N. Y. (M)
Howell, Swebston S., Jr., Mot-Pic. Lab. Techn., U.S. Navy. Mail: 902 Kenyon Dr., Alexandria, Va. (A)
Hudyma, Joseph P., Cinematog., General Motors Photographic. Mail: 16825 Pinehurst, Detroit 21. (A)
Hull, Wayne M., Physician, Retired, 2036 Brightwaters Blvd., St. Petersburg 4, Fla. (A)

Jack, Neil P., Jr., Stagehand, Elect., Sound, National Broadcasting Co. Mail: 13316 Ratner St., N. Hollywood. (A)
Jacobs, Robert M., Univ. So. Calif. Mail: 1561 Minerva Ave., Anaheim, Calif. (S)
Jacobson, George, Dir. Photo., Normandie Productions Ltd. Mail: 106 Washington Pl., New York 14. (M)
Jamison, Frank L., Jr., Univ. Calif. Mail: 612 Landfair Ave., Los Angeles 24. (S)
Jewell, James E., Theatre Engr., C.J. Holzmueller, Lighting. Mail: 1110 Howard St., San Francisco 3, (A)
Johnson, Hugo C., Free-Lance Cameraman, 1506 Live Oak Dr., Silver Spring, Md. (M)
Johnson, Robert B., Design Eng., Eastman Kodak Company, 400 Plymouth Ave., N., Rochester, N. Y. (M)
Jones, Arthur F., Mot.-Pic. Producer, Artray Ltd. Film Productions, 1219 Richards St., Vancouver 2, B.C., Can. (M)

Kerman, Stephen D., Rensselaer Polytech. Inst. Mail: 453 Fulton St., Troy, N. Y. (S)
King, Robert W., Design Eng., Traid Corporation, 17136 Ventura Blvd., Encino, Calif. (A)
Kirshner, Harry, Pres., Park Photo Supply Co., 77 Craig St., W., Montreal, Que., Can. (M)
Kjeldsen, Holger C., Film Editor, Byron, Inc., 1224-26 Colonial Dr., Orlando, Fla. (A)
Koelemeyer, Louis A., Developing-Printing, Trans-Canada Films, Ltd., 1212 Burrard St., Vancouver, B.C., Can. (A)
Konwea, Robert C., L.A. School. Mail: 1130 W. 36 St., Los Angeles 7. (S)
Korff, Arthur, Broadcast Eng., Columbia Broadcasting System. Mail: 69-40 Yellowstone Blvd., Forest Hills 75, N. Y. (M)
Krall, Harry J., Devel. Eng., Eastman Kodak Company, Kodak Park Works, Bldg. 35, Rochester, N. Y. (A)
Krauss, Robert L., Engineering Photo., Ford Tractor & Implement Div. Mail: 984 Larkmoor Blvd., Berkley, Mich. (A)
Krentz, Thomas V., TV Workshop. Mail: Woodward Hotel, 55th & Broadway, New York 19. (S)
Kruger, Karl H., TV Techn., Columbia Broadcasting System. Mail: 51 Alexander St., Apt. 905, Toronto, Ont., Can. (A)
Kurth, Clarence H., Univ. So. Calif. Mail: 3021 S. Shrine Pl., Los Angeles 7. (S)
Kurtz, Gary D., Univ. So. Calif. Mail: 942 W. 34 St. (Touton Hall), Los Angeles 7. (S)

Laberheim, Richard, Film Techn., Movielab Film Labs. Mail: 5372 65th Pl., Maspeth 78, Queens, N. Y. (A)
LaRoche, Karl, Jr., Administrator, BMEWSS Project, RCA Service Co. Mail: 3 Manor Rd., Cinnaminson Township, Palmyra, N. J. (M)
Law, Lloyd G., Lab. Techn., R. H. Ray Film Ind. Mail: 2285 Benson Ave., St. Paul, Minn. (A)
LeClede, Tod, Asst. Cameraman, Filmaster Prod. Mail: 731 North St. Andrews Pl., Hollywood 38. (A)
Leigh, A. Norman, Chief Gaffer, MPO TV Films, Inc. Mail: 178-40 Wexford Terrace, Jamaica Estates 32, N. Y. (M)
Lemoine, Hyatt, Jr., Sound Supvr., Yale Univ. Audio Visual Center. Mail: 314 Winthrop Ave., New Haven, Conn. (A)
Lennert, Frank G., Manager, Ampex Corp. Mail: 745 Evergreen St., Menlo Park, Calif. (M)
Lepnis, Andis, American Inst. Engr. & Tech. Mail: 5401 S. Ellis Ave., Apt. 9, Chicago 15. (S)
Levinson, L. A., Photo. Research Scientist, Technicolor Corp. Mail: Star Route, Agoura, Calif. (M)
Lewis, Elbert M., Sales Eng., Ampex Corporation. Mail: 1175 Orilla Court, Los Altos, Calif. (M)
Liu, Robert F., Dir., Educational Film Studio, National Academy of Arts & Crafts, Banchiao, Taipei, Taiwan. (M)
Lubow, Sheldon J., Editorial Room Asst., Screen Gems. Mail: 8701 Shore Rd., Apt. 539, Brooklyn, N. Y. (A)

Maguire, Frank J., Production Mgr. Mot.-Pic., Peliculas Candiani, S.A., Avenida Popocatepetl, #166, Mexico 13, D.F., Mex. (A)
Mann, Alfred E., Physicist, Spectrolab, Inc., 7423 Varna Ave., N. Hollywood, Calif. (A)
Manteuffel, Ralph J., Photo. Techn., USAF. Mail: R.D. 2, Box 28-B, Theodore, Ala. (M)
Markley, Paul F., Univ. Miami. Mail: 6454 S. W. 33rd St., Miami 55, Fla. (S)
Marshall, Murray W., Maint. Eng., S. W. Caldwell Ltd. Mail: 9 Wingreen Court, Don Mills, Ont., Can. (M)
McCarty, Malcolm D., Manager, Geophysical Lab., Magnolia Petroleum Co. Mail: 4401 Wildwood Rd., Dallas, Tex. (M)
McDonald, Leo W., Newsfilm Supvr., National Broadcasting Co. Mail: 1525 Crest Rd., Silver Spring, Md. (M)
McNally, John P., Chief Eng. & Vice-Pres., TVR Inc. Mail: Zanoni St., Woodcliff Lake, N. J. (M)
McWilliams, V. Paul, Photo., Real Estate Advertising Associates, Inc., 2200 W. 75 St., Kansas City 15, Mo. (M)
Mikhailoff, Vadim, Univ. So. Calif. Mail: 4444 Prospect Ave., Los Angeles 27. (S)
Miller, Donald C., Film Director, State University of South Dakota, Vermillion, S. D. (A)
Mitchell, John C., Photo-Optics Eng., Philco Corp. Mail: 2084 Windsor Ct., San Leandro, Calif. (A)
Montano, Benjamin, Sales Mgr. Studio Dept., Dexsa, S.A. Mail: Panuco 170-D, Mexico 5, D.F., Mex. (A)
Moore, Ronald W., Mich. State Univ., 2001 Harding Ave., Lansing 10, Mich. (S)
Moriarty, John M., Sr. Design Eng., Eastman Kodak Co., A & O Division, 400 Plymouth Ave. N., Rochester 4, N. Y. (M)
Morrall, William R., Editor, Film Production, Arabian American Oil Co. Mail: Box 1668, Aramco, Dhahran, Saudi Arabia. (M)
Morris, Richard B., Test Eng., International Harvester Co. Mail: 1331 Gilbert Ave., Downers Grove, Ill. (A)
Muskey, Nicholas C., Supvr., Bekins Film Service Center, 1025 N. Highland Ave., Hollywood 38. (A)

Nelson, Leonard V., Owner, The Family Camera Store, 1732 Miramonte Ave., Mt. View, Calif. (A)
Nichols, Dwight O., Free-Lance Cinematog., Eureka Springs, Ark. (A)
Nielsen, Egon C., Producer, Cinema Vue Corp. Mail: 541 E. 20 St., New York 10. (A)
Nogle, John G., Optical Cameraman, Consolidated Film Ind. Mail: 3277 Stoner Ave., Los Angeles 66. (A)
Nothdurft, Major Robert H., Chief Lab. Br., U.S. Army Pict. Center. Mail: 2498 Third Ave., East Meadow, N. Y. (M)

Ogiso, Hiroshi, Dir., Tokyo Theatre Supply Co., Ltd., #4, 5-Chome, Shiba Shimbashi, Minato-ku, Tokyo, Japan. (A)
Olshin, Milton, Free-Lance, Process Projection. Mail: 90 Winthrop Ave., Yonkers, N. Y. (M)
Ong, Hian Yao, Radio Eng., Broadcasting Corp. of China. Mail: 53 Ren-AI Road, Section 3, Taipei, Taiwan. (A)
Otteson, Lou M., Experimental shop supt., Retired, 1171 N. Madison Ave., Los Angeles 29. (A)

Patterson, A/3c Victor J., 4750th A.D.S., Vincent A.F.B., Ariz. (A)
Perella, Frank A., Sound Techn., Fordel Films. Mail: 160 Cabrini Blvd., New York 33. (A)
Pergolizzi, Louis, Univ. So. Calif. Mail: 3721 Mentone, Los Angeles 34. (S)

Peterson, Thomas F., Jr., Pres., General Mgr., Industrial Cine Prods. Mail: 3060 Lander Rd., Cleveland 24, O. (A)
Petroni, Giulio, Dir., Cameraman. Mail: Via Ximenes, 3, Roma, Italy. (M)
Pett, Dennis W., Instructor, Indiana Univ. Mail: 1902 Maxwell, Bloomington, Ind. (A)
Phillips, David R., Photo., Monsanto Chemical Company, Lindbergh & Olive St. Rd., St. Louis, Mo. (A)
Placerean, Frank J., Projectionist, Schines Monroe Theatre. Mail: 78 Ridgedale Circle, Rochester 16, N. Y. (A)
Platnick, Ray, Free-Lance Newsreel Cameraman, 157 Lindenmere Dr., Merrick, N. Y. (A)
Power, Harold R., Mot.-Pic. Eng., State Film Centre. Mail: 6 Glendearg Grove, Malvern, Vic., Australia. (M)
Powers, Frederick W., Supvr., General Eng., QM Airborne Test Activity, Yuma Test Station, Ariz. (A)
Price, Alan L., Sales Eng., Fairchild Camera & Instrument Corp. Mail: 1928 Loring Place, S., New York 53. (A)

Ray, Gordon R., Mot.-Pic. & Art Dir., Reid H. Ray Film Ind. Mail: 7305 14 Ave., S., Minneapolis 23, Minn. (M)
Reese, Warren B., Vice-Pres., Macbeth Corporation, Box 950, Newburgh, N. Y. (M)
Reinemund, John H., Mot.-Pic. Producer Dir., Armed Forces Radio TV Services. Mail: 2064 Argyle Ave., Hollywood 28. (A)
Reisman, Alexander, Univ. So. Calif. Mail: 11458 Burbank Blvd., N. Hollywood. (S)
Reynolds, Keith Y., Video Tape Operator, National Broadcasting Corp. Mail: 3717 Los Feliz Blvd., Los Angeles 27. (A)
Richardson, Newell, Cinematog., 44 W. 53 St., New York 19. (M)
Ricketts, Courtland C., Lyons Township Jr. Coll. Mail: B & K LaGrange Theatre, 80 S. LaGrange Rd., LaGrange, Ill. (S)
Robb, Glenn D., Timer, Graphic Films. Mail: 98 Third Ave., Ottawa, Ont., Can. (A)
Roizen, Joseph, Electronic Eng., Ampex Corp. Mail: 3540 Ramona Ave., Palo Alto, Calif. (M)
Roizman, Owen I., Free-Lance Asst. Mot.-Pic. Cameraman, 330 Golf Dr., Oceanside, N. Y. (A)
Roizman, Sol, Free-Lance Mot.-Pic. Photo., 330 Golf Dr., Oceanside, N. Y. (M)
Root, Walter C., Eng., Sylvania Electric Products Inc., 405 Fourth St., Ann Arbor, Mich. (A)
Rose, Benjamin, Vice-Pres., Micro Record Corp. Mail: 487 South Ave., Beacon, N. Y. (A)

Sammis, Raymond R., Photo. Quality Control Specialist, RCA Service Co. Mail: 1062 Rivermont Dr., Eau Gallie, Fla. (A)
Santemma, Hector, Photo. Chemical Control, Movielab Color Corp. Mail: 60 Hinckley Pl., Brooklyn 18, N. Y. (A)
Santone, Urban H., Cameraman, 61 Lindbergh Pl., Crestwood, N. Y. (A)
Sawyer, Cliff, Mot.-Pic. Sales & Service, Birns & Sawyer Cine. Mail: 8910 Santa Monica Blvd., Los Angeles 46. (A)
Schmidt, Thomas L., Univ. So. Calif. Mail: 17622 Willard St., Northridge, Calif. (S)
Schmitz, Charles A., Sound Techn., J. Walter Thompson Co. Mail: 4737 Matilda Ave., New York 70, N. Y. (A)
Seeley, James, Dir., Photo., RCA Service Co. Mail: 521 Sea Gull Dr., South Patrick Shores, Eau Gallie, Fla. (M)
Seidel, Carlos A., Tech. Director, Lowes Argentina. Mail: Guido Spano 305, Martinez F.C. Mitre, Buenos Aires, Argentina (A)
Sharon, Joseph L., Univ. So. Calif. Mail: Box 403, Hermosa Beach, Calif. (S)
Shea, Walter E., Sales Repr., Eastman Kodak Company, 1000 Connecticut Ave., Washington 6, D. C. (M)
Sheaff, Donald J., Mot.-Pic. Film Lab. Supvr., USAF. Mail: 8125 Variel Ave., Candea Park, Calif. (A)
Shenfeld, Gary, Univ. Miami. Mail: 1242 Walsh Ave., Apt. E, Coral Gables 46, Fla. (S)
Shultz, Bob J., Photo., Cinematog., Minneapolis-Honeywell Corp., 1915 'Armacost Ave., Los Angeles 25. (A)
Silverman, Lawrence, Asst. Dir., Audio-Visual Production Center. Mail: 26023 Allor, Huntington Woods, Mich. (A)
Silz, Henri L., Chief Photo., U.S. Navy. Mail: 42 E. Melrose St., Valley Stream, N. Y. (A)
Simone, Peter E., Film Techn., Consolidated Films Ind. Mail: 624 Oleander Dr., Los Angeles 42. (A)
Skalsky, Alfred F., Univ. So. Calif. Mail: 751 S. Normandie Ave., Apt. 10, Los Angeles 5. (S)
Skee, Vincent J., Pres., Electronic Applications, Inc. Mail: 78 Old Hill Rd., Westport, Conn. (M)
Smith, Clyde B., Mot.-Pic. Prod., University Extension, University of California, Berkeley 4, Calif. (A)
Smith, J. Aubrey, Film Prod., Visual Educ., Georgia Agricultural Extension Service, University of Georgia, Athens, Ga. (M)
Smith, Lorin H., Wholesale Distrib., Watkins Products. Mail: 2225 Encino Pl., Pomona, Calif. (A)
Smith, William C., Free-Lance Mot.-Pic. Cameraman, 59-41 58th Ave., Maspeth 78, N. Y. (M)

Professional Services

Snyder, Raymond, Photo. Eng., U.S. Army Signal Equip. Supply Agency. Mail: 2209 Appleby Dr., Wanamassa, N.J. (M)
Souville, Laurence W., Jr., Univ. So. Calif. Mail: 3634 Kalsman Dr., Los Angeles 16. (S)
Stechly, Michael, Sales Mgr., McCurdy Radio Ind. Mail: 1063 Haig Blvd., Port Credit, Ont., Can. (M)
Storz, William J., Free-Lance Cinematog., 89-10 63rd Ave., Rego Park 74, N. Y. (M)
Subandi, Raden, Camera & Lab. Maint., Perusahaan Film Negara, Bidara Tjina 125, Djakarta, Indonesia. (A)
Sullivan, Jack M., Mot.-Pic. Projectionist-Cameraman, Texan Theatre, Box 1, Greenville, Tex. (A)
Sullivan, John B., Mot.-Pic. Prod., Sullivan-Bruce Productions Inc., 707 S. Brand, Glendale 4, Calif. (A)

Thornton, Fred, Mot.-Pic. Photo., Cornell Aeronautical Lab., 4455 Genesee St., Buffalo, N. Y. (A)

Vuke, George J., Indiana Univ. Mail: R.R. 5, Bloomington, Ind. (S)

Walters, Glenn R., Mot.-Pic. Prod., Owner, Valdhere Co. Mail: 2600 Far Hills Ave., Dayton 19, O. (A)
Warren, Eugene D., Develop. Eng., Columbia Broadcasting System. Mail: 205 Old Wilmet Rd., Scarsdale, N. Y. (A)
Weber, Herbert M., Eng., Unicorn Engineering Corp., 817 Mills Bldg., Washington 6, D. C. (M)
Weitzman, Moses, Optical Effects Editor, Timer, Eastern Effects. Mail: 34-15 Parsons Blvd., Flushing 54, N. Y. (M)
Welch, Clifford A., Dir. U.S. Naval Training Aids Center. Mail: 139 Atherwood Ave., Redwood City, Calif. (M)
Welch, John A., Manager, National Theatre Supply Co. of Asia. Mail: 20 The Drive, Bardon W4, Queensland, Australia. (A)
Wenzel, Kurt W., Prod., Cameraman, U.S. Information Agency, Foreign Prod. Dept., IMS. Mail: 117-26 239th St., Elmont, N. Y. (M)
Wiegman, David, Jr., TV Network Newsreel Film Cameraman, National Broadcasting Co. Mail: 1801 Glen Park Dr., Silver Spring, Md. (A)
Wing, John P., Free-Lance Asst. Cameraman, 90 Elizabeth St., New York 13. (A)
Witherell, William R., Jr., Producer, Video Films. Mail: 528 Rivard Blvd., Grosse Pointe 30, Mich. (A)

Young, P. C., Projection Eng., Loews, Inc. Mail: 8961 Kramerwood Pl., Los Angeles 34. (M)

Zinaman, Joe, Owner, Animation Studio, 2700 Shadow Lane, Nashville, Tenn. (M)

REINSTATED

Lawrence, Paul R., Production Mgr., TV, Radio & Film Comm., Methodist Church, 1525 McGavock St., Nashville, Tenn. (A)
Magargle, Hal, Mixer & Transmission Eng., Cinerama, Inc. Mail: 38 Bluebird Dr., Syosset, N. Y. (A)
Miller, Charles H., Photo., Timer, USAF. Mail: 4780 Burkhardt Ave., Dayton 3, O. (A)
Rideout, Edward H., Jr., Sr. Engineering Photo., Avco Research & Advanced Develop., 750 Commonwealth Ave., Boston. (M)
Young, Marty, Independent Prod., Business & Industrial Films, 3024 Fort Worth Ave., Dallas, Tex. (M)

SMPTE Test Films

Test films planned by the Society's technical committees and produced under the Society's exact supervision are available from the headquarters office at 55 West 42 St., New York 36. Catalogs containing brief descriptions of each film are obtainable on request.

Films are available in the following categories:

Television—Picture Only, Color or Black-and-White
CinemaScope
Visual 35mm—Picture Only
Magnetic — 16mm Sound Only
Picture and Sound — 16mm
Picture Only — 16mm
Glass Slide — 16mm

new products (and developments)

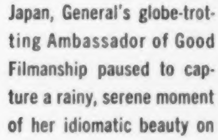
Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

The high-speed, rotating-prism, 16mm camera produced by Eastman-Kodak Co. has been acquired by Beckman & Whitley Inc., San Carlos, Calif. The camera's main application is in the study and analysis of rapid mechanical motion. It is capable of taking pictures at rates from 1000 to 3200 frames/sec. Manufacture, distribution and servicing will be carried out by the California firm.

The Dynafax Camera is a lightweight, portable, high-speed, motion-analysis camera. It is designed for simple, fast film processing and uses standard 35mm film. A product of Beckman & Whitley, 973 E. San Carlos Ave., San Carlos, Calif., it is designed to photograph at an upper rate of 25,000 frames/sec. Other design features include a stable framing rate during the operating cycle, continually indicated on a built-in meter; absence of synchronizing requirements; exposure times adjustable between 1 and 5 μsec at the maximum rated framing speed of the camera; total writing time of 9 msec at 25,000 frames/sec, and adaptability to the use of any 16mm cine lens in a "C" mount. Dimensions are 12 in. in diameter, 10 in. in length, with a weight of 28 lb. It is priced at $4950.00.

A new Avco Kerr Cell Shutter is described in a 4-page brochure. The cell is designed for photography at exposures down to 0.01 μsec (*Journal*, July 1958, p. 507) and is available from Avco Research and Advanced Development Div., 201 Lowell St., Wilmington, Mass. The brochure is illustrated with charts, drawings and photographs.

Purchase of Hi-C Products Co., of Pasadena, Calif., has been announced by Photo Research Corp., 837 N. Cahuenga Blvd., Hollywood. In making the announcement, Karl Freund, President of the Hollywood firm, said that plans were underway for a greatly accelerated program for marketing the firm's line of magnifying monocular viewfinders for Mitchell, Auricon, Wall and other cameras, as well as focusers and boresights which will bear the Photo Research Corp. Spectra label.

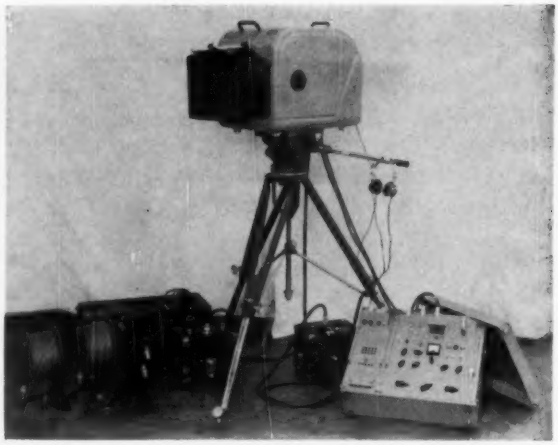


Television coverage of the U.S. Air Force World-Wide Weapons Meet (William Tell) at Tyndall Air Force Base, Fla., dramatized new applications of television to missile programs. During the Meet, Dage airborne transistorized cameras were placed in an F-102 and a TF-102 jet aircraft to transmit views to TV receivers located throughout the base area of interceptor action taking place at points as far distant as 150 miles from the receivers.

The firing of drones, approach of interceptor aircraft, scoring on drones and other action in the air were televised to a special mobile TV unit and a TV control unit on the flight line. Information received at the control center was then relayed to a Philco transmitter for broadcast over Channel 4 to standard receivers.

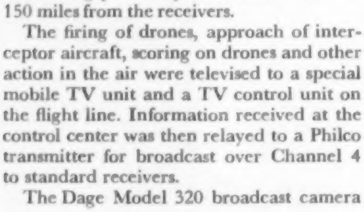
The Dage Model 320 broadcast camera was used to cover the scoreboard and action on the flightline ramp. Another 320 camera, mounted on top of the control tower, monitored movements, takeoffs and landings of interceptor aircraft. A third broadcast camera was used in the control center for on-the-ground viewing. In-the-air activity was also covered from the GCI radar control center and showed aircraft movements on radar. TV recordings were made of the telecasts on 16mm film for the Air Force. The inset in the illustration shows a Falcon missile fired from the F-102 "Delta Dagger" interceptor.

Among other equipments used at the Meet is the Traid T-560 Fotomatic high-speed camera which was the only optical scoring recorder used in drone-scoring operations.



The Camerette Double-System Sound Camera has been announced by Houston Fearless Corp., 11827 West Olympia Blvd., Los Angeles 64. The camera will use either 16mm or 35mm photographic film as well as 16mm or 35mm fully coated magnetic sound film and can be instantly converted for either use. The unit is contained in a glass fiber blimp. The recorder and camera are driven by a 24-v synchronous d-c motor with a special governor for speed stability. The amplifier unit is contained in a separate case and operates from a 24-v battery. Two microphone input channels are provided, each with input amplifier, gain control and high and low frequency tone controls. Film capacity is 400 ft. The recorder can be operated independently for nonsynchronized soundtracks. A selector switch in a separate playback amplifier enables the operator to hear either direct signal or playback.

A special telescope arrangement is provided on the camera, a 16/35mm Eclair Camerette (Patents Coutant-Mathot), which carries the eye piece to the back of the blimp to adjust for either 16mm or 35mm frame size. Follow-focus control is provided on the blimp. The unit weighs about 100 lb. It is 24 in. long, 15 in. wide and 17 in. high. The price, including camera, recorder and blimp is about $15,000.00.



Two laboratory research instruments, rotating-mirror and rotating-drum cameras, have been developed for sale by the Research and Advanced Development Div., Avco Manufacturing Corp., 201 Lowell St., Wilmington, Mass. The cameras are used in studies of radiation, explosive compound development, solid fuel ignition, propulsion, ballistics combustion, chemical recombination, plasma tunnels, magnetohydrodynamics, spark gap discharges, high-speed electromechanical units such as relays, and other transient events which emit or reflect light.

The rotating-mirror camera which records position vs. time relationships is designed about a hexagonal, first surface mirror, rotating at 3000 rps, which provides writing speed of 4 mm/μsec for a total writing time of 50 μsec. It has a cast aluminum main housing, standard $f/2.5$ lens, two curved film holders and air turbine drive.

The rotating drum camera, in addition to making position-time film records, also may be used with a densitometer to produce accurate data of hypervelocity phenomena. In conjunction with a schlieren system it will produce μsec-order photographic frames for graphical analysis. A dynamically balanced drum, rotating at 600 rps for writing speed of 0.18 mm/μsec, distinguishes this second instrument. The fast emulsion film is fixed to the inner periphery of the drum. Both cameras operate on compressed air driven through shaped nozzles at turbines integral with either the rotating mirror or drum units.

The Mark IV television camera channel has been announced by Marconi Wireless Company Ltd., Chelmsford, Essex, Eng. The design is based on the company's Mark III camera channel which incorporates the $4\frac{1}{2}$-in. image orthicon. The new camera weighs less than 100 lb and uses only 12 valves which include seven Mullard Type E88CC. Among other new features are an image orbiting device designed to prevent "sticking" on static pictures and a new picture and waveform monitor with 14-in. picture and 5-in. waveform tubes. Units are being installed in Canada and Australia.

A ruggedized closed-circuit TV camera has been developed by Allen B. Du Mont Laboratories Inc., 750 Bloomfield Ave., Clifton, N.J., to withstand extremely high acoustic noise, shock, vibration or even an explosion. Available either as a transistor-type or with subminiature tubes, dimensions of both types are $3\frac{1}{4}$ in. by $3\frac{5}{8}$ in. by $10\frac{1}{2}$ in. For remote operation, the camera, focus, turret and iris motors are mounted in a small housing measuring 5 in. by 7 in. by 12 in. All remote accessories and the housing are available in the standard product line of the firm's industrial TV equipment, making it possible to use the standard three-lens remote drive turret for the new cameras. The transistorized camera (Du Mont TC-200-RT) is priced at $1000.00 and the subminiature tube camera (Du Mont TC-200-RS) is $900.00.

A lightweight high-resolution aerial panoramic camera developed by Perkin-Elmer Corp., Norwalk, Conn., enables meteorologists to analyze the structure of storms and to predict their movement. The camera, which weighs 50 lb fully loaded, employs a rotating prism to "wipe" the image on film. On each exposure, it covers 180° horizon-to-horizon perpendicular to the plane's flight path and 42° with the flight path. Measuring only 38 in. by 19 in. by 8 in., it is adaptable for use in small places. It was first used by the Weather Service of the Air Force last November to photograph the 30-mile-wide "eye" of Typhoon "Kit." Other applications include military operations, geological survey work, soil conservation studies and other fields requiring extremely wide-angle continuous aerial photographic coverage of terrain. A clock and bubble-level for roll and pitch determinations are superimposed on each exposure for accurate time and point references needed in indexing.

The MTS-4 System, a transistorized, ruggedized TV system which makes possible the use of closed-circuit TV within military aircraft, ships and vehicles to transmit visual data to one or more monitors has been announced by Dage Television Div., Thompson Ramo Wooldridge Inc., Michigan City, Ind. Weighing 55 lb, it consists of three components, camera, control and monitor. All three units are transistorized. The system is designed to require minimum adjustment of controls.

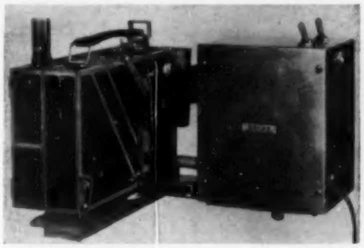
A paper on TV Broadcast Repeaters presented at the 12th Annual NAB Broadcast Engineering Conference, Los Angeles, by Byron W. St. Clair is available in the form of a 6-page illustrated brochure from Adler Electronics Inc., 1 LeFevre Lane, New Rochelle, N.Y. Also available is a transcript of a statement by Benjamin Adler before a Senate Committee conducting hearings on S. 2119, a bill containing provisions for governmental support of educational TV.

A mobile color TV studio has been designed in a 35-ft, 18-ton aluminum trailer for use by the Army Signal Corps for on-the-spot coverage of training and operational activities. The studio-on-wheels was designed and developed for the Army Pictorial Center, Long Island City, New York, by General Electric Technical Products Dept., Electronics Park, Syracuse, N.Y. About eight tons of color equipment which ordinarily would require four or five times more space have been fitted into the trailer. In addition to studio control equipment, the trailer has special compartments for three color cameras and audio equipment for recording, taping and transcribing.

Type G-801 Program Equalizer has been announced by Magnasync Mfg. Co., Ltd., 5546 Satsuma Ave., North Hollywood. Weighing 6½ lb, the instrument measures 19 in. by 3½ in. by 3½ in. It has standard Western Electric hole spacing and high and low frequency controls. The impedance is 500–600 ohms; insertion loss, 14 db; input level, minimum −70 dbm; maximum +20 dbm. It is priced at $159.00.

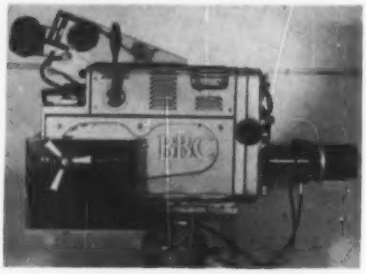
New developments described at the Annual Convention of the Society of Photographic Scientists and Engineers held in October in Rochester, N.Y., included a low-intensity ultraviolet sensitometer and a special camera designed for photography of shipboard radar screens. The sensitometer, designed by Raymond F. Newell of Eastman Kodak Co.'s film testing division, exposes film to ultraviolet radiation in a series of calibrated steps. The instrument is used for testing large volumes of film and plates produced for spectrographic work in such fields as chemical analysis and metallurgy. The source of energy is a germicidal lamp. A sector wheel, turning at 1700 revolutions per minute provides exposure of the film to ultraviolet radiation in the required series for ease in testing film sensitivity.

A camera, described by Devlin A. Chubb, Abrams Instrument Corp., is used for radar picture records containing time of sighting and radar range. Such information would be valuable for legal reference in cases of aircraft accident or maritime collision.



A single-frame camera motor to operate any type of 16mm or 35mm camera with single-frame crank has been announced by Rolab Photo-Science Laboratories, Sandy Hook, Conn. The motor with gear train and magnetic clutch brake is enclosed in an aluminum box with the driveshaft extending from one side. A standard tripod thread on the bottom of the box permits easy mounting of the unit near the camera so that the driveshaft and the crank fitting on the camera can be connected by a short (approximately 2-in.) rubber or plastic tubing. Upon contact (by pushbutton, foot switch or intervalometer) the driveshaft makes a full turn and stops automatically.

The cycle takes two seconds during which the light circuit is "ON" in synchronism with the open sector of the camera shutter. A switch on top of the unit permits the motor to be run continuously for faster operation. Another switch turns the light circuit "ON" permanently for setting up the camera or for focusing. An inlet is provided for the connection of the remote pushbutton or foot switch for single-frame work for animation or film strip production. For time-lapse cinematography an intervalometer takes the place of the switch. The unit is priced at $69.50.



A new studio zoom lens developed by Taylor, Taylor & Hobson Ltd., a Division of Rank Precision Industries, 37–41 Mortimer St., London, W1, in cooperation with the British Broadcasting Co., has been announced. The lens, called the Studio Varotal, was described in a paper at the SMPTE Fall Convention in Detroit by Gordon Henry Cook. Interchangeable rear units are provided so the lens can be used with both image-orthicon and vidicon cameras. The focal length range is $2\frac{1}{4}$ to 8 in. on image-orthicon cameras and $2\frac{1}{4}$ to 8 cm on vidicon cameras. The maximum relative aperture for image-orthicon and vidicon is $f/4.5$ and $f/1.8$, respectively, and image diagonal covered is 40 mm for image orthicon and 16mm for vidicon. Correction of lens aberrations matches the spectral sensitivity of the tube and aberrational compensation has been provided for the errors introduced by the face of the tube. The lens is designed to fit existing camera turrets with a minimum of adaptation. The three controls — focus, zoom and iris — are in the form of worm gears mounted toward the rear of the lens to facilitate the fitting of either manual or servo drives.

A system of automatic electronic focusing called Optical Automatic Ranging (OAR) has been announced by Comapco Inc., a company organized to develop and license applications of this system. Five features incorporated in the system, as outlined in the announcement, are: (1) a suitable focusing device — either a refractive lens or a reflective mirror system — which has a magnification of less than unity and forms a "real optical image" of any illuminated object placed in front of it; (2) within the focal area of such optical image an oscillating "sensor." This is a sensitive photoelectric cell system in continuous motion back and forth along the optical axis within a predetermined range. The sensor's varying output of electrical energy corresponds to the varying intensity of radiant energy which it encounters at each point of its constant back-and-forth travels; (3) a signal amplifier which multiplies the varying electrical information from the sensor and passes it along to (4) a servoamplifier which converts the information into electrical instructions to be followed by (5) a servomotor. This motor operates to move the lens or mirror system until the plane on which is focused the image of the object being "sighted" lies precisely at the midpoint of the sensor's oscillations.

This system is designed to monitor or measure continuously varying light intensities and has the advantage of not requiring complicated optical elements in the path of the light rays.

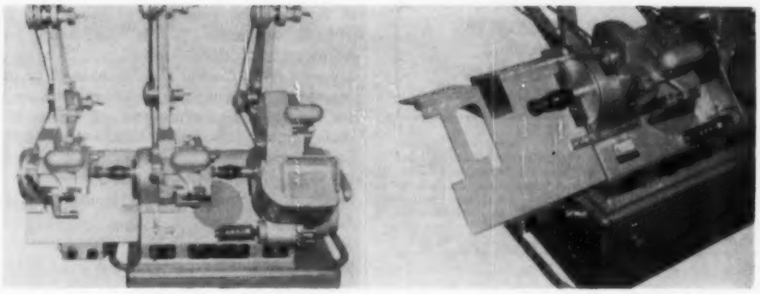
Two new theaters have been installed at Pinewood Studios, Ivor Heath, near London, by the G.B.-Kalee Division of Rank Precision Industries Ltd., 37-41 Mortimer St., London, W1. The larger theater (No. 5) (47 ft long, 30 ft wide and 20 ft high) is intended for viewing rushes and for routine dubbing and re-recording. The floor of the theater consists of strips of different surfaces such as boards fixed to rafters, narrow boards on a firmer foundation, wood blocks, paving stones, gravel, sand, cobbles and linoleum; there are also staircases, both bare and covered, so that the sound of footsteps can be made appropriate to the picture. A shallow tank is used for water effects. A trough can be flooded for the sound of feet splashing through water or dragging through mud.

For sound reproduction the theater is equipped with a conventional No. 2 Duosonic type of speaker assembly. The screen is suitably proportioned for VistaVision projection. Mole-Richardson lighting equipment makes it possible to film small inserts in the theater. The monitor room with a viewing window adjoins the theater and contains a 3-channel mixer desk Type 1291. The projection room is equipped with a pair of G.K. 20 projectors with President arc lamps. The lamps, running at 60 amp, are fed from studio d-c power. Picture brightness is standardized at 12 ft-L. In the recording room, a G.K. cabinet-type magnetic recorder is maintained, together with test equipment and patching facilities. The recorder is driven by an interlock motor and operates either independently or in interlock with either of the theater projectors and cabinet reproducers.

The small theater (No. 6) also consists of the theater, monitor room and a projection room with a pair of G.K. 20 projectors with President arcs but with double film attachments. This small theater contains a 6-way dubbing mixer console Type 1336 which can accommodate two recordists. Theater sound for preview projection may be controlled either from the console or the projection room.

The recording room is equipped with a G.B.-Kalle magnetic recorder. In a separate power room are two interlock generators, one a standard large set capable of running all the equipment in full interlock, and the other a smaller set intended for running only the recorders. Both are wired through a power and control panel and are operated by remote control.

A new polyfocus lens attachment, announced by Karl Heitz Inc., 480 Lexington Ave., New York 17, is designed to convert the 12.5mm and 35mm lenses for the Camex Reflex 8mm single lens camera into zoom-type lenses of variable focal length. By moving a lever, the focal length can be changed to create simulated dolly effects. With a built-in reflex finder the attachment may be used with lenses for any 8mm camera. It is priced at $129.00.



The Camart Add-A-Unit Extension Plate for the Moviola series of editing machines is a product of Camera Mart, Inc., 1845 Broadway, New York 23. The accessory is designed to enable the film editor to use more than one separate optical or magnetic soundhead. The additional soundhead with takeup arm is mounted on the extension plate and the cables are connected to the amplifier. Parts such as belt guards and the flexible coupling assembly are included in the unit as well as volume controls. The design provides for the addition of other plates to accommodate as many soundheads as desired. The price is $325.00.

A new projector light source, described as "revolutionary" by both British and American reporters, was introduced by Philips-of-the-Netherlands at the Photokina Exposition in Cologne, Germany. The Philips SPP Gas Discharge Lamp is entirely unlike the xenon lamp. It is a quartz tube 80 mm long with a maximum diameter of 5.6 mm. It operates with a pulsating direct current at 72 impulses per sec, or 3 impulses per frame. Because the valve-type light switches electronically on and off in fractions of a second, need for a rotary shutter is eliminated. Reports from early tests indicate that the new light source is sufficient for a 50-ft screen. A specially designed projector, the Philips FP 20-S, is used with the lamp. The frame of the projector is a steel housing pressed as a single unit of rectangular cross section. It incorporates the curved running plate used in an earlier projector, the DP 70.

The lamp is contained in a sealed housing and is water-cooled. At a current consumption of 800 w, its brightness is reported to be 20 ft-L. The high current intensity during the impulse peaks is reported to result in a uniform spectral energy distribution permitting excellent projection of color film. Plans have not been completed for distribution in the United States.

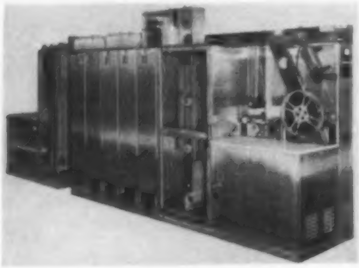
Shown above is the lamp turret of the FP 20-S projector with two SPP lamps. The "working" lamp has been removed.

Field tests conducted by National Carbon Co. have demonstrated the technical superiority of larger negative arc carbons with double-tapered ends, the firm reports. The new design makes possible a much faster initial "burn-in" period and more steady arc operation. A taper is added to the tapered end of the larger negative carbons to form the double tapered ends, presently available in the five larger sizes of Ortip negative carbons. Prices are the same as for corresponding single-tapered carbons.

A reflectance-type exposure meter, described as a "first," has been designed specifically for high-speed photography and introduced by the Industrial Products Div. of Fairchild Camera and Instrument Corp., Robbins Lane, Syosset, L.I., N.Y. Designated the HS3201, it is designed for Fairchild Motion Analysis Cameras and measures only the amount of light that reaches the film. Light readings are taken from the camera position by sighting on the subject. Operation of either the high- or low-range buttons on the underside of the meter gives a dial reading for the field. Correct aperture setting can be read directly from the ring scale, preset to the film speed. Specifications are: size, 8 in. by 3½ in. by 2¼ in.; acceptance angle, 2°; light value ranges, low from 0 to 25,000 ft-c, high from 0 to 500,000 ft-c; picture taking rate scale, 100, 200, 300, 400, 500, 1M, 2M, 3M, 4M, 5M, 10M, 15M, 20M; aperture setting scale, *f*/1.0, 1.4, 2.0, 2.8, 4.0, 5.6, 8.0, 11, 16, and 22. It is priced at $179.50.

Newly appointed distributor for Portman Animation Stand, and accessories, is the firm of Florman & Babb Inc., 68 W. 45 St., New York 36. A catalog describing the equipment is available without charge from the firm.

A new 5-ft-wide fume hood has been added to the line of Steelab fume hoods. Designed to protect laboratory personnel from dangerous fumes, the cabinets are made of heavy-gauge Bonderized steel with a finish of chemical-resistant enamel. Working tops of Alberene stone are provided. The fume hood and accessories are described in a two-page bulletin available from Arthur S. LaPine Co., 6001 S. Knox Ave., Chicago 29.



A new 16/35mm daylight black-and-white film processor has been announced by HiSpeed Equipment Inc., 73 Pond St., Waltham 54, Mass. Reported to operate at 65 ft/min negative and 130 ft/min positive with guaranteed gamma curves, the machine is modular designed with dimensions 12 ft long, 2½ ft wide and 6 ft high. Features include open sprays, an easy access impingement dryer to provide full view of the drying operation and built-in accessories designed ready to connect to water, power and drain. The machine was exhibited at the SMPTE Convention, Oct. 20–24, at Detroit, Mich.

The Ramo-Wooldridge Corp., organized five years ago to conduct research, development and manufacturing operations in the field of electronics and missile systems, has been merged with its affiliate, Thompson Products Inc. The new firm is known as Thompson Ramo Wooldridge Inc. The name Thompson Products will be retained by the company's present automotive divisions. Names of Thompson Products Ltd., Toledo Steel Products, Ramsey Corp., Bell Sound Systems, Dage Television and Kolcast will remain the same. The Tapco Group and Ramo-Wooldridge will retain their names and operate as divisions of the new company. The Space Technology Laboratories division has been made a separate corporation. In addition to its space technology activities, the company has engaged in systems work in such areas as digital computers and control systems, communications and navigation systems, infrared systems and electronic countermeasures.

A lightweight sound-level meter, Type 1551-B weighing 7½ lb, has been announced by General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. The instrument features such improvements as a built-in reference circuit which eliminates the need for 115-v, 60-c line, a redesigned amplifier for improved signal-to-noise ratio, and direct reading over a sound-level range of 24 db to 150 db. It is priced at $395.00.

The Teclite, a lightweight (less than 30 lb) 16mm projector has been announced by Technical Service Inc., 30865 Five Mile Rd., Livonia, Mich. A detachable 8-in. speaker, included in the single-case unit, responds to a newly designed 15-w, a-c, d-c amplifier. Designed mainly for industrial and educational applications, dimensions are 14 in. by 11¾ in. by 13 in.

Exposed Ektchrome Commerical film may be sent to Colour Film Services Ltd., 22/25 Portman Close, Baker St., London W1, for processing. This laboratory has been approved by the Research Laboratory of Kodak Ltd., England, as being fully equipped for satisfactory processing of the film.

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Motion-Picture Engineer. Available for new position February 20, 1959; will consider job in any part of the world. Now completing contract with Reevesound Co., New York, installing laboratory overseas. Formerly with Capital Film Labs, Washington, D.C., for several years. Have designed and built lab equipment for a number of years for the trade (firm name in Washington, D.C., is Telex Films). Have the experience to do capable work in production, editing, sound or lab. Complete résumé upon request. Would prefer any new overseas assignment to start by March 10, 1959. Write airmail: Victor E. Patterson (USOM), American Embassy, APO 271, New York, N. Y.

Television Engineer. French citizen, 7 yrs experience TV research in Paris, subsequently engineering manager of TV station in Casablanca, Morocco, seeks position in United States or Mexico, preferably with an American company. Degrees in electrical and radio engineering. Age 34, married. Write: Lucien Chareyre, 37 rue de Mareuil, Casablanca, Morocco.

Cameraman-Editor experienced in all phases of film production, feature films, commercials, TV documentaries, sound recording and laboratory. Desire permanent position with production company or television station. Will work in studio and/or anywhere on location. Knowledge of French, Italian and Arabic. Write to A. P. Mamo, 7945 Cartier Street, Montreal, Quebec, Canada.

Motion-Picture Production. Experienced in film production, studio and location, educational, industrial and TV films. 15 years in industrial films, 6 years producing TV commercials. Seeking a position as production executive with a commercial or industrial motion-picture unit. Experienced in various phases of film production; operated most 35mm and 16mm cameras, directed industrial films, produced TV commercials. Excellent references. Résumé on request. Write: Edw. A. "Jack" Price, 2417 Crest Ave., South Bend 14, Indiana.

Educator - Cameraman - Producer. Available every summer for either industry or education. Experienced in educational films, TV commercials, public relations films, newsreel work and live educational television. Degrees: B.S. in Ed., M.A. Interested either in production or organization, setting up program and teaching others to carry on. Also interested in any type of employment in motion-picture industry for which qualified. Experienced in every technical phase of motion-picture production. Own complete production equipment, cameras, sound, lights, etc. Age 42. Teacher in winter. Available from June 12 to Labor Day. Salary open. Henry E. Eisenkramer, 7550 Washington Ave., University City 5, Mo. VOlunteer 3-5669.

Chemistry and Chemical Physics. Director of Research and Experimental Engineering for 20 yrs, predecessor of Harris Intertype Corp.; over 70 patents and applications in photographic and photomechanical fields; member many scientific organizations. Special interests: light sensitive substances, developers, phototypesetting, highspeed data recording, photopolymerization. Overseas contacts in research and development. Available full time or on a consulting basis. Would relocate. William H. Wood, Route 1, Box O, Rockbridge, Ohio.

Motion-Picture Writer, Director or Unit Manager with some TV experience returning from 8 yrs work in Middle East. B.A., M.A. in Cinema from USC. Wants position with vigorous film or television company. Have family, will relocate. Résumé on request. Write: John H. Humphrey, Apt. 604 West, 74-10 35th Ave., Jackson Heights, N. Y.

Photographic Administrative and Technical Specialist. 21 yrs experience in laboratory administration, sales administration, selling, quality control, personnel supervision, camera work and production. Heavy experience in color with leading laboratory. Seeking connection in administrative capacity with major TV or film company. Detailed resume on request. Willing to relocate. Robin R. Lewis, 4 Arbor Rd., Syosset, N. Y. WAlnut 1-0063.

Audio-Visual Production. Freelance experienced in all phases of audio-visual production wants assignments on West Coast. Fully equipped for 35mm slidefilms, slides and 16mm motion-picture production; also equipped for editing. References available. Write: J. S. Paul, c/o J-Me Films, P.O. Box 6143, Bakersfield, Calif.

Producer-Writer. Motion-picture and educational TV experience. B.S. Quantitative Biology, MIT, 1957; B.S. Motion Pictures, Boston Univ.,

1955. Age 25. Single, locate anywhere. Complete resume on request. Write: Marc E. Finkel, 44 Kimball Rd., Chelsea 50, Mass.

Theatre Sound and Projection Technician, 37, married, seeks position with Canadian theatre supply company. Experienced in installation of theatre projectors and some theatre sound and p.a. systems, maintenance of Simplex and other projectors, sound work on Ballantyne and other sound systems; first class B.C. projectionist since 1949 (in projection 13 yrs); qualified TV service technician, have built own test equipment including VTVM, signal generator, oscilloscope, complete television receiver and miscellaneous electronic test equipment. Employed as projectionist by Famous Players Canadian Corp. since 1950; seeks position that will further utilize qualifications; willing to relocate anywhere in Canada. Write: A. P. Mulcahy, 604 Nicola St., Kamloops, B.C., Canada.

Industrial Photographer, cameraman, producer. Broad experience: still and motion pictures production; camera, editing, darkroom b&w and color printing and processing, transparency duplication. 18 yrs working practice in industrial, commercial, educational, scientific, medical and documentary films. Good knowledge of production and use of audio-visual media. Presently working as production supervisor for a large color lab, but finishing agreement and available on short notice. Good background, master's degree; ambitious and reliable personally, Spanish language; able to manage production unit, design and organize a photo dept. Have some equipment, will relocate. Write M.G., 68-46 Groton St., Forest Hills 75, N.Y.

Motion-Picture Production, Presentation. Energetic, versatile, age 26. Thoroughly experienced in all technical phases of motion-picture production, 16 & 35mm, including formulation, writing and editing of scripts for TV commercials, educational, industrial, R&D and public relations films. Work experience includes: Prod. Asst., Elliot-Unger-Elliot Motion Pictures and TV Commercials; Coordinator, Audio-Visual Dept., Univ. of Miami; just completed 2 yrs military service, U.S. Army Ord. as motion-picture director, technical writer and cinematographer. Productions distributed internationally. "SECRET" clearance, U.S. Army Ord. Eduction: BBA degree, supplemented by courses in electronics, education, technical writing, journalism and composition. Willing to relocate. Resume on request. Available for personal interview with films and scripts. Larry Ross, 55 Payson Ave., New York 34. Williams 2-0560.

Motion-Picture Cameraman, Technician. Active member SMPTE now employed at medium market TV station photographing, processing and editing news and commercial 16mm footage. Owner of two motion-picture cameras, lenses, tripods, lights, etc. Desires connection with producer of industrial, scientific, educational, religious or travel films. Available on 30 days notice. Résumé on request. Frank E. Sherry, 915 Mockingbird Lane, Tyler, Texas. Tel: LYric 3-4337.

Electronic Engineer. Television Major, B.S.E.E., age 28, vet, 4 yrs military electronics and radar and 1 yr TV experience, specializing in broadcasting and recording. Knowledge of color and microwave systems. Competent in magnetic, photographic and kinescope recording. Thesis written on magnetic video tape recorders. Desires position in motion-picture sound or TV studio engineering. Civilian or military projects. Foreign or domestic assignments. Fluent in German. Excellent references. Available June 5, 1959. Andis Lepnis, 5401 So. Ellis Ave., Chicago 15, Ill.

Positions Available

Cameramen. Staff position. References and resume of experience required. Confidential. **Sound Technicians.** Experience, references. Permanent position. **Laboratory Technicians.** Timing experience. Permanent position. Write: I. C., 423 East 90 St., New York 28.

Television Engineers. Positions available for television engineers meeting the following minimum requirements: (a) BS degree with a minimum of 1 yr of TV equipment design on camera equipment, broadcast or industrial systems; or (b) 4 yrs experience on television design work in lieu of BS degree with 1 yr spent on television camera design. Young and expanding company located in smog-free Orange County, close to beaches and downtown Los Angeles. Excellent living conditions. Salary dependent upon experience and education. Send complete resume to Personnel Dept., Interstate Electronics Corp., 707 E. Vermont Ave., Anaheim, Calif.

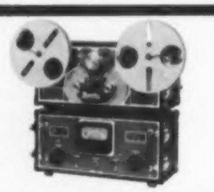
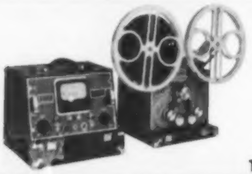
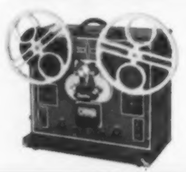
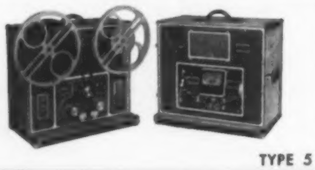
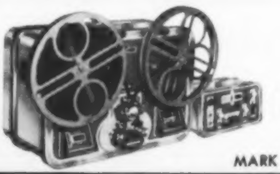
8mm Movie Design Engineer, Production Engineer, Development Engineer. These are specific openings in our 8 mm movie program. Applicants must be graduate engineers with experience in engineering and manufacturing amateur motion-picture equipment. These openings are the result of a strong new products program at Argus Cameras and offer a rare opportunity to use your past experience in the motion-picture field with a growing and progressive company. Send resume to Employment Manager, Argus Cameras, Ann Arbor, Mich., stating age, education, work history and salary requirements.

Laboratory Control. Philadelphia motion-picture laboratory wants young man. Will have complete responsibility for mixing and sensitometric control of B&W processing chemicals and mechanical maintenance of Bell & Howell printers including balancing of exposure lights. Chemical and mechanical background plus knowledge of motion-picture laboratory techniques required. Send reply to Louis W. Kellman, 1729 Sansom St., Philadelphia 3, Pa.

Photo Engineer. Experienced in motion-picture and still production, high-speed, metric color and black-and-white; able to direct complete production unit including labs, motion-picture and still, writers, photography, editing. Applicants should have education and experience to assume heavy project responsibility.
Laboratory Supervisor—Motion Pictures. Assume complete responsibility for lab operation including developing, printing, quality control, black-and-white and color.
Laboratory Supervisor—Still Lab. Assume complete responsibility, still lab, black-and-white and color. Cameraman, Engineering. High-speed, engineering test films. Experienced Fairchild, Fastax, Traid, Bell & Howell.
Applicants for above positions should be willing to relocate. Write for appointment, including resume, to: P.O. Box 189, Times Square Station, 340 West 42 St., New York 36.

Senior Optical Engineer. Direct development proprietary line of high-speed cameras and other photographic instruments. Must have analytical ability and research or development experience with optical devices or photographic instrumentation; able to plan and carry out projects from inception through prototype stage. Position carries full technical responsibility and should be attractive to qualified applicants with managerial potential. Salary open. Advanced degree desirable. Plant located in pleasant suburban area near San Francisco. Contact George Bingham, Beckman & Whitley, Inc., 973 E. San Carlos Ave., San Carlos, Calif.

*How to select a recorder to start your MAGNASYNC-MAGNAPHONIC SOUND SYSTEM

Sound Equipment Checklist		LIGHTWEIGHT	MEDIUM WEIGHT	16 MM FILM	17½ MM FILM	35 MM FILM	REWIND	FOOTAGE COUNTER	POWER AMPLIFIER	MONITOR SPEAKER	TORQUE MOTORS	PLUG-IN AUDIO	PUSH BUTTON CONTROL	REMOTE CONTROL	SLIDE-WIRE POTS	FILM MONITOR	SYNKINETIC MOTION	PLUG-IN HEADS
 X-400	When lightweight portability is a **must** the 27 lb. X-400 Type 1 is the answer! Another reason so many producers choose this machine is that it is genuinely professional, and yet, surprisingly economical! From $985.	X		X			X	OPTIONAL	OPTIONAL	OPTIONAL						X	X	OPTIONAL
 TYPE 1	The Type 1 is a miniaturized version of the Type 5. Low power consumption and extreme portability has made this 39 lb. unit a popular selection for remote location production by leading professional motion picture studios. From $1360.	X		X	X		X	X	X	OPTIONAL		X				X	X	OPTIONAL
 TYPE 15	The X-400 Type 15 is designed for the man who wants everything in one case . . . playback amplifier, monitor speaker, footage counter and torque motors. You can be proud to have this machine represent you on any sound stage! From $1385.		X	X			X	X	X	X	X					X	X	OPTIONAL
 TYPE 5	The most popular magnetic film recorder in the world is the Type 5! With this unit and all its operational conveniences, you are definitely in the "major league." The Type 5 owner always starts his pictures with a special feeling of confidence in the realization that he has allowed no compromise in the selection of equipment. From $1570.		X	X	X	X	X	X	X	X	X	X				X	X	OPTIONAL
 MARK 1X	There is nothing on the market that compares with the remarkable Mark 1X. This unit is in a class by itself . . . with push-button remote controlled relay functions, plug-in audio elements and all the "extras" that make for flawless recording under the most adverse conditions. From $2145.		X	X	X	X	X	X	X	OPTIONAL	X	X	X	X	OPTIONAL	X	X	X

**Regardless of the model you select, you can always depend upon equipment with the "Magnasync-Magnaphonic" label . . . equipment made by the international leaders in the design and manufacture of quality magnetic film recording systems.*

Write, wire or phone

MAGNASYNC MANUFACTURING CO., LTD.

5546 Satsuma Ave., North Hollywood, California • STanley 7-5493 • Cable "MAGNASYNC"

DEALERS: **CHICAGO,** Zenith Cinema Service, Inc.; **LOS ANGELES,** Birns & Sawyer Cine Equipment; **NEW YORK,** Camera Equipment Co.; **SAN FRANCISCO,** Brooks Camera Co.; **BELGIUM,** Brussels, S.O.B.A.C., S.A. (Societe Belge D'Applications Cinematographiques); **BOLIVIA,** La Paz, Casa Kavlin; **BRAZIL,** Rio de Janeiro, Mesbla, S.A.; **CANADA,** Toronto, Ontario, Alex L. Clark, Ltd.; **DENMARK,** Copenhagen, Kinovox Electric Corp.; **ENGLAND,** London, W-1, Delane Lea Processes, Ltd.; **HONGKONG,** Supreme Trading Co.; **INDIA,** Bombay, Kine Engineers; **ITALY,** Rome, Reportfilm S.R.L.; **JAPAN,** Tokyo, J. Osawa & Co., Ltd.; **MEXICO CITY,** D.F., Henri A. Lube; **PAKISTAN,** Karachi 3, Film Factors Ltd.; **SWITZERLAND,** Zurich 7/53, Rene Boeniger; **THAILAND,** Bangkok, G. Simon Radio Co., Ltd.

Contents — pages 40 – 64

News Columns

Advertisers

Meeting Calendar

American Physical Society, Mar. 6, 7, Univ. of Texas, Austin, Texas.

Electrical Engineers Exhibition, Mar. 17–21, Earls Court, London.

IRE National Convention, Mar. 23–26, Waldorf-Astoria Hotel & New York Coliseum, New York.

American Physical Society, Mar. 30–Apr. 1, Hotel Somerset, Boston & MIT, Cambridge, Mass.

Inter-Society Color Council, 28th Annual Meeting, Apr. 1, 1959, Statler-Hilton Hotel, New York.

Optical Society of America, Apr. 2–4, Hotel New Yorker, New York.

Armour Research Foundation, 4th Conference on Industrial Instrumentation and Control, Apr. 14, 15, Ill. Inst. of Technology, Chicago.

American Physical Society, Apr. 30–May 2, Willard & Raleigh Hotels, Washington, D.C.

Electro-Chemical Society, 7th Annual Semiconductor Symposium, May 3–7, Sheraton Hotel, Philadelphia.

85th Semiannual Convention of the SMPTE including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.

IRE 7th Region Technical Conference and Trade Show, May 6–8, Univ. of New Mexico, Albuquerque, N.M.

Acoustical Society of America, May 14–16, Ottawa, Ont.

IEE, Transistors and Associated Semiconductor Devices, International Convention, May 21–27, Earls Court, London.

American Rocket Society, June 8–11, San Diego, Calif.

International Commission on Illumination, 14th Congress, June 15–24, Brussels, Belgium.

International Symposium on Circuit and Information Theory, June 16–18, Univ. of Calif., Los Angeles.

American Physical Society, June 18–20, Milwaukee, Wis.

American Society for Testing Materials, Annual Meeting, June 21–26, Chalfont-Haddon Hall, Atlantic City, N.J.

86th Semiannual Convention of the SMPTE including Equipment Exhibit, Oct. 5–9, Statler, New York.

87th Semiannual Convention of the SMPTE, May 1–7, 1960, Ambassador Hotel, Los Angeles.

88th Semiannual Convention of the SMPTE, Fall, 1960, Shoreham Hotel, Washington, D. C.

89th Semiannual Convention of the SMPTE, Spring, 1961, Royal York, Toronto.

90th Semiannual Convention of the SMPTE, Oct. 15–20, 1961, Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1958 Journal, Part II.

sustaining members

of the Society of Motion Picture and Television Engineers

The objectives of the Society are:

- Advance in the theory and practice of engineering in motion pictures, television and the allied arts and sciences;
- Standardization of equipment and practices employed therein;
- Maintenance of high professional standing among its members;
- Guidance of students and the attainment of high standards of education;
- Dissemination of scientific knowledge by publication.

Progress toward the attainment of these objectives is greatly aided by the financial support provided by the member companies listed below.

Acme Film Laboratories, Inc.
Alexander Film Co.
Altec Service Company
  Altec Lansing Corporation
Ampex Corporation
Animation Equipment Corp.
Ansco
C. S. Ashcraft Mfg. Co.
The Association of Cinema
  Laboratories, Inc.
Atlas Film Corporation
Audio Productions, Inc.
The Ballantyne Company
Bausch & Lomb Optical Co.
Bell & Howell Company
Berndt-Bach, Inc.
Burnett-Timken Research Laboratory
Byron, Inc.
S. W. Caldwell Ltd.
The Calvin Company
Capital Film Laboratories, Inc.
Oscar F. Carlson Company
Century Lighting, Inc.
Century Projector Corporation
Cineffects, Inc.
Cinesound, Ltd.
Geo. W. Colburn Laboratory, Inc.
Color Reproduction Company
Color Service Company, Inc.
Columbia Broadcasting System, Inc.
  CBS Television Network;
  CBS Television Stations; CBS News;
  CBS Film Sales; Terrytoons
Comprehensive Service Corporation
Consolidated Film Industries
Dage Television Division of Thompson
  Ramo Wooldridge Inc.
Andre Debrie Mfg. Corp.
DeFrenes Company
DeLuxe Laboratories, Inc.
Desilu Productions, Inc.
Du Art Film Laboratories, Inc.
Dupont Company of Canada, Ltd.
E. I. du Pont de Nemours & Co., Inc.
Eastern Effects, Inc.
Eastman Kodak Company
Electronic Systems, Inc.
Elgeet Optical Company, Inc.
Max Factor & Co.
Filmline Corporation
General Electric Company
General Film Laboratories Corporation
General Precision Laboratory
  Incorporated
W. J. German, Inc.
Guffanti Film Laboratories, Inc.
The Harwald Co., Inc.
Frank Herrnfeld Engineering Corp.
Hollywood Film Company
Hollywood Film Enterprises Laboratory
Houston Fearless Company
Hunt's Theatres
JM Developments, Inc.
The Jam Handy Organization, Inc.
Jamieson Film Co.
The Kalart Company, Inc.
  Victor Animatograph Corporation
Kling Photo Corp. (ARRI Div.)
Kollmorgen Optical Corporation
Lorraine Orlux Carbons
J. A. Maurer, Inc.
  Precision Film Laboratories, Inc.
Mecca Film Laboratories, Inc.
Mitchell Camera Corporation
Mole-Richardson Co.
Motion Picture Association of America,
  Inc.
  Allied Artists Products, Inc.
  Columbia Pictures Corporation
  Loew's Inc.
  Paramount Pictures Corporation
  RKO Radio Pictures, Inc.
  Twentieth Century-Fox Film Corp.
  United Artists Corporation
  Universal Pictures Company, Inc.
  Warner Bros. Pictures, Inc.
Motion Picture Printing Equipment Co.
Movielab Film Laboratories, Inc.
Moviola Manufacturing Co.
National Carbon Company, A Division of
  Union Carbide and Carbon Corporation
National Screen Service Corporation
National Theatre Supply Company
Northwest Sound Service, Inc.
Panavision Incorporated
Pathé Laboratories, Inc.
Prestoseal Mfg. Corp.
Producers Service Co.
Rank Precision Industries Ltd.
Reid H. Ray Film Industries, Inc.
Reeves Sound Studios, Inc.
Charles Ross, Inc.
S.O.S. Cinema Supply Corp.
Shelly Films Limited (Canada)
The Strong Electric Company
Technicolor Corporation
Titra Film Laboratories, Inc.
Trans-Canada Films Ltd.
Tri Art Color Corporation
Van Praag Productions
Alexander F. Victor Enterprises, Inc.
Westinghouse Electric Corporation
Westrex Corporation
Wilding Picture Productions, Inc.
Wollensak Optical Company

The Society invites applications for Sustaining Membership from other interested companies. Information may be obtained from the Chairman of the Sustaining Membership Committee: Byron Roudabush, c/o Byron, Inc., 1226 Wisconsin Ave., N.W., Washington 7, D.C.